

THE

ELGI

MAGAZINE

RESEARCH AND INNOVATION

Flex Air

Bleed airend

PRODUCT FOCUS

Deflating

GLOBAL WARMING

Nitrogen Tyre Inflator from ATS ELGI

LIFE TODAY

Hills of Hope

SPECIAL FEATURE

Life Saving Air

Compressed air in nature

COVER FEATURE



50 YEARS
OF
ENDURING
PARTNERSHIPS



Enduring
Partnerships



Message from the **Managing Director**

Dear Readers,

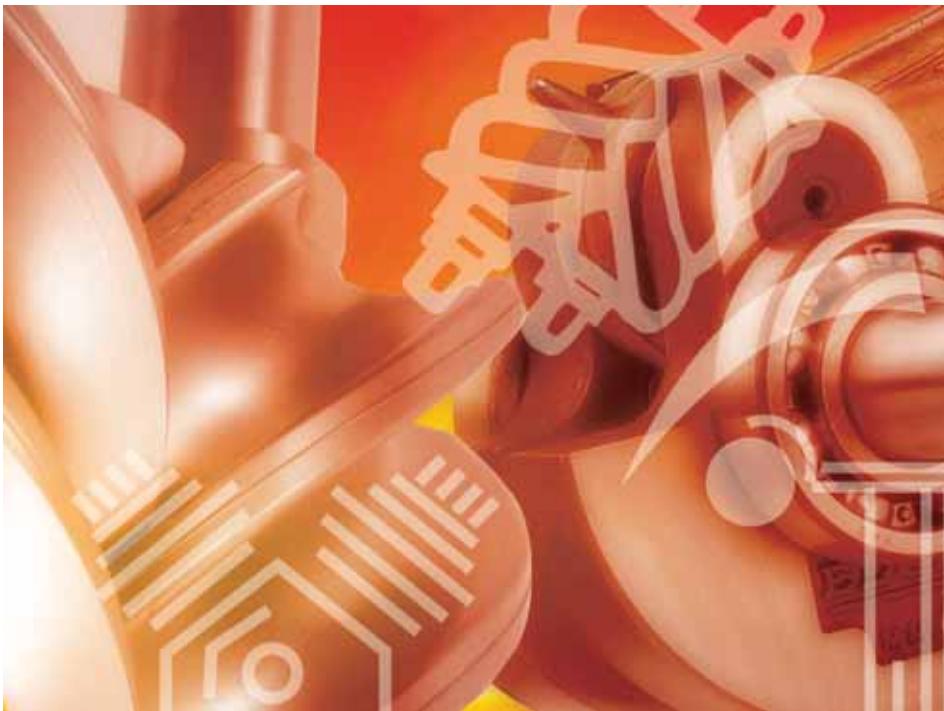
As we pause and reflect on our fifty years of history, we are discovering many interesting facets about our company. One strong line that cuts across most of these facets is the engagement with our customers and their importance to our growth. Each line of business that we are in has a unique story about how our customers helped us start and then grow the business. We did not have the benefit of advanced management and marketing tools, but nevertheless we were a "customer centric" company in practice.

Along with this strong commitment to customers, our people were equally important players in making this commitment a reality. Generations of employees have absorbed and practiced this philosophy and this has in no small measure contributed to what we are today. From this view of the past we look at the future with a renewed commitment to this philosophy and take it to another level of practice.

We resolve ourselves to develop products and services that are focused on customer's stated needs and unstated wants, manufacture products and services of quality that are world class which will make us proud and deliver the products and services effectively to customer's expectations.

We thank you for your support and continued patience and we will ensure that your partnership with us is a rewarding experience.





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VOLUME 6 APRIL 2010 - MARCH 2011

MANUSCRIPT AND ART

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Printed at:

ACE DATA Prinexcel Private Ltd.

Image Courtesy:

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www.askandyaboutclothes.com, [sanofi-aventis](http://sanofi-aventis.com),
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EDITORIAL NOTE

Dear Reader,

As always, it is with great pleasure that we bring out this new issue of Elgi Magazine. This time our delight is enhanced by a great sense of excitement. Shortly before this magazine went to print, Elgi Equipments began its year-long golden jubilee for it was in March 1960 that the company began operations. We mark this important period of celebration by presenting you a photographic feature on the first 50 years of Elgi Equipments.

In this edition, we carry articles on a selection of compressed air applications in different industries—from printing and water treatment to pharmaceutical drug manufacture and hydroelectricity generation.

The destination near Coimbatore that we highlight this time is the delightful Nelliampathy Hills. In the Nature and Compressed Air section, we look at potentially lethal micro-organisms that meet their Waterloo when faced with compressed air.

We highlight the Nitrogen Tyre Inflator from ATS Elgi, apart from taking a look at new products from Elgi Equipments, Elgi Sauer and ATS Elgi.

Elgi has initiated recently the Personal Effectiveness Programme, wherein yoga is practised daily by all at the company—there is an article on this programme in the issue.

We wish you happy reading and welcome your responses.

The Editors, Elgi Magazine



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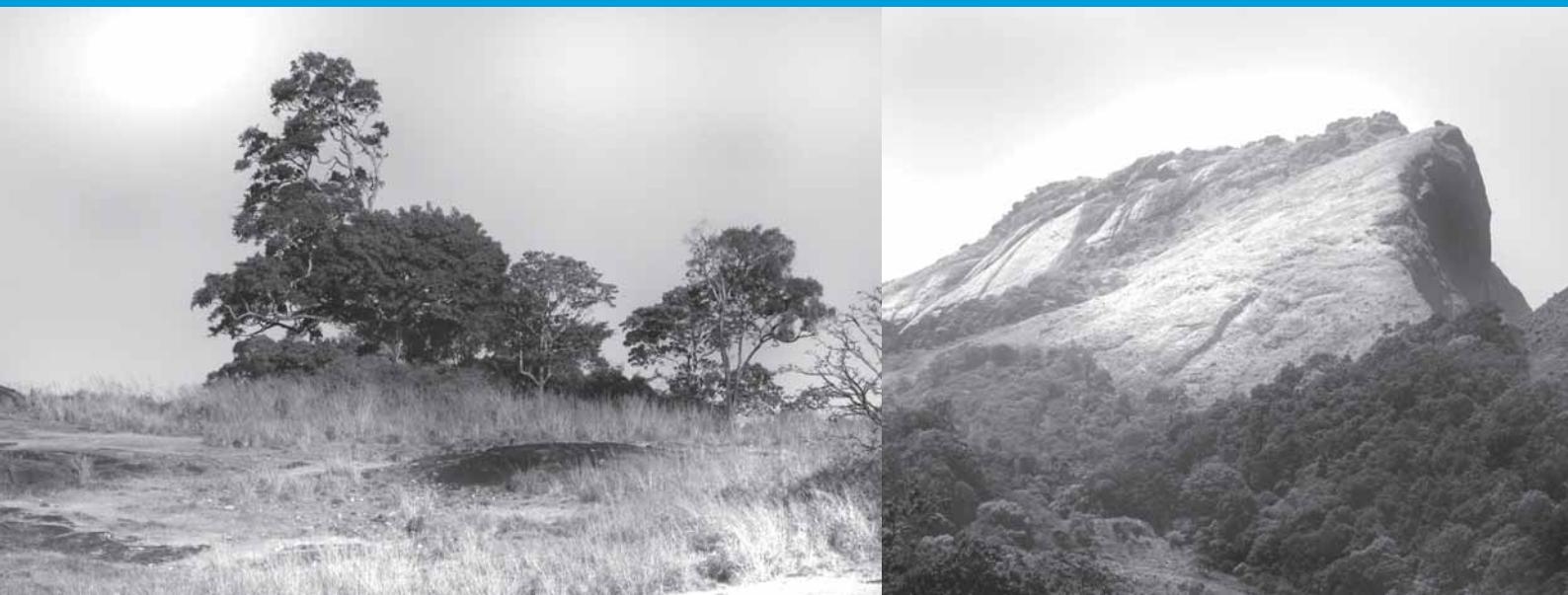
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THE NELLIAMPATHIES

Hills of HOPE

INTRODUCTION

Years ago, I was invited to accompany a friend on a visit to the Nelliampathies. My memories of the visit have grown somewhat indistinct, but a few images remain etched from my first trip to the Nelliampathy Hills.

Our journey from Palghat - where we reached by train - proceeded by road, driving through the small Kerala town of Nemmara, reaching the hills soon after. Once at the hills, we stayed in a coffee estate at Padagiri. Though much of our time was spent in meetings and discussions, we did manage to look around the estate and even made an excursion to an adjoining forest.

One of the lasting images from the visit was that of a tribal wedding. A simple ceremony, it was performed at a shrine, sacred to the local people and located in the forest. At the end of the wedding, an elderly gentleman went into a trance. He began to move jerkily, bowing and rising himself and drawing his breath in with sharp noises. The intense performance served to draw everyone's attention away from the newly married couple.

The weather was rather dry at the time of our visit, and the coffee plants were drooping from the drought. On the coffee bushes, one of us discovered a strange caterpillar. It was as large as caterpillars could go, but little could be seen of it apart from its head. It had



enclosed itself in a case made of neatly snipped lengths of thin twigs that had apparently been glued together. As the caterpillar moved about, it dragged its armour along with it, so that it looked quite singular. I knew the young ones of certain moths or butterflies were known as faggot-worms, and I guess our caterpillar was one of these.

A third image that I retain from the visit is that of a Great Pied Hornbill in the estate. Now, a Great Pied Hornbill is a very large bird, made particularly conspicuous by black-and-white plumage and even more spectacular by an enormous curved yellow bill. To add to the effect, this hornbill sports an appendage atop the bill that is known as a casque, which can be described as boat shaped - this is a description as good as any other. Whereas the Great Pied Hornbill is a wary bird in most of the forests it lives in and is rare to see in general, here it was perched on a tree at a low height, sitting nonchalantly as though it were nothing more than a crow. The sight provoked much excitement amongst us, and we were told that the hornbills here were rather tame and that it was not unusual to see them around the estate.

THE KINLOCHS

One of the planters who lived in the Nelliampathies during the early part of the 20th century was one Angus M. Kinloch. His father was Major General A.A. Kinloch, a well known sportsman and the author of *Large Game Shooting in Tibet, Himalayas and Northern India*.

A.M. Kinloch inherited from his father an interest in hunting and natural history. He seems to have lived in Kotagiri, in the Nilgiris, before moving to Palagapandy Estate on the

HOW TO REACH THERE

Nearest Airports:

Cochin International Airport and Coimbatore Airport

From Cochin Airport:

Come to Thrissur - 30 km; take a taxi or bus from Thrissur bus stand to Nemmara - 48 km.

From Coimbatore Airport:

Come to Palakkad - 50 km; take a taxi or bus to Nemmara - 30 km. From Nemmara you can take a taxi or a four wheeler vehicle (jeep) to Nelliampathi.

Nearest main railway stations: Palakkad, Thrissur and Coimbatore





NORTHERNMOST RANGE OF THE SOUTHERN DIVISION

The largest break in the Western Ghats, that large and significant geographical feature of peninsular India, is known as the Palghat Gap. The Gap is around 24 kilometres wide and is named after the city of Kerala located in it. The terrain here is level, cultivated and dotted freely with palmyrah trees, so that it resembles the plains of Tamilnadu more than a typical rolling tract of Kerala.

The hill range at the north of the Palghat Gap is known as the Palghat Hills, and the range at the south is the Nelliampathies. To the south of the Nelliampathy Hills are Parambikulam and the Anamalais, extending southwards into the High Range, the Cardamom Hills and the other ranges of the southern Western Ghats.

Four sections have been identified in the Nelliampathies:

The northern slopes: These rise very steeply from the plains, forming cliffs that are 'cut by an occasional gully'. This section is covered in deciduous jungle.

The plateau country: This consists of undulating land, and it has patches of coffee cultivation and lemon grass. The forest here is of a dense evergreen type.

The higher ranges: Consisting of peaks reaching up to 5000 feet above sea level, these ranges are clothed in grass, punctuated with *sholas*, which are evergreen forests found in the higher altitudes of the Western Ghats.

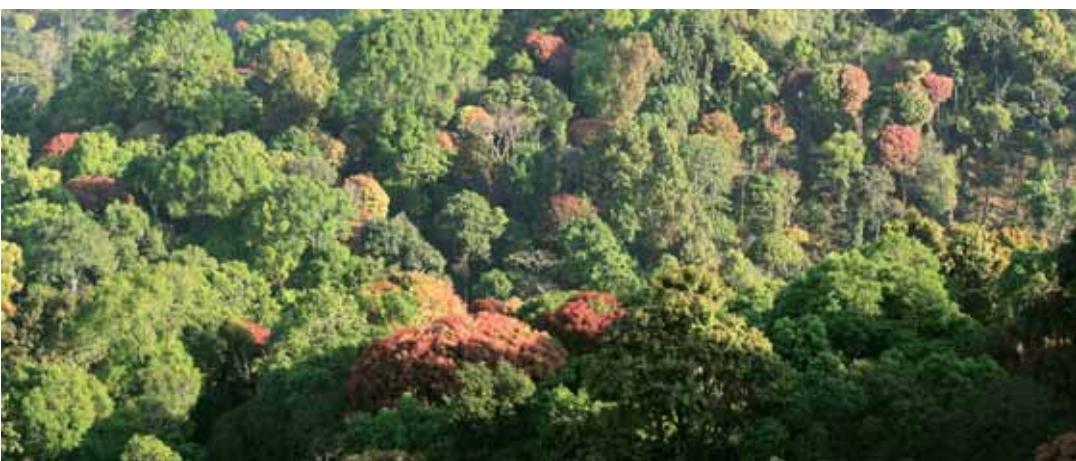
The southern slope: The southern slopes of the Nelliampathy Hills are gradual. These slopes lead into an extensive valley. There are evergreen forests in the centre and in the western part, and the eastern forests are more deciduous.

As with most other parts of the Western Ghats, the south-west monsoon rains have a significant role in the climate of the Nelliampathies. The rainy season begins in June and extends up to September and October. There are continuous spells of heavy rainfall during the monsoon. The British found the prevailing climate and the fertile soil to be suitable for the cultivation of coffee, oranges and tea. These crops they brought into the Nelliampathy Hills.

Nelliampathy Hills. An old member of the Bombay Natural History Society (BNHS), he constantly contributed specimens to its museum. The journal of BNHS published quite a number of interesting notes by him on the animals of the hills.

In 1921, A.M. Kinloch was in Kotagiri on holiday, where he went on a wild boar hunt. He had wounded a big boar and was following it up alone through thick scrub when the animal charged at him at close quarters. The boar's teeth sliced through Kinloch's femoral artery, killing him instantly. We know that A.M. Kinloch was survived by his wife and at least two children, one girl and one boy.

The boy was A.P. Kinloch, Angus Peter Airlie Hamilton Kinloch to give his name in full. Angus Peter was described as being a good planter and a very hard worker and as having a very wide circle of friends. He served in France with distinction during the First World War, being wounded twice there.



A.P. Kinloch was destined to die young. He suffered continuously from the effects of his wartime injuries. In February 1927, just six years after his father was killed, he died of heart failure at his estate aged only 31.

In his short life, A.P. Kinloch was, if anything, an even more enthusiastic and keen naturalist than his father. He joined the BNHS in 1912, when he was just 16 years old. He was also a fellow of the Zoological Society and a member of the British Ornithological Union. When the BNHS organised a survey of the mammals of India, A.P. Kinloch rendered all assistance in the field. He, like his father, was a keen contributor to the journal of the BNHS.

The Kinlochs' notes and articles on the wildlife of the Nelliampathies are wide ranging. They deal with the larger mammals, birds and reptiles of these hills, apart from smaller creatures such as ants and leeches. Thanks to these publications, we have a picture of the rich fauna that was found in the Nelliampathy Hills when the British planters had established themselves there.

FASCINATING ACCOUNTS

On 10 January 1927, exactly a month before his death, A.P. Kinloch speculated, in a note he sent for publication in the journal of the BNHS, about man-eating tigers. The killing and eating of humans by tigers, incidentally, seems to be far rarer in southern India than in the rest of the country. 'I wonder if it is common for a tiger to make a solitary human kill and then renounce such food?', he wrote, and continued as follows:

About two years ago a gang of coolies were regulating shade in a young tea clearing on these hills. At mid-day they went to their

lines for food leaving one of their number behind. He presumably fell asleep. On their return all that was left of him was his cloth and bill-hook. They noticed tiger tracks and ran off to call the writer (the spot was about 10 yds. from a public road in full view and very much within hearing of a set of cooly lines). The writer some hours later pluckily (or foolishly) followed the tracks out of the tea and into some dense lantana where the top of the man's skull was found and further on the headless and limbless trunk. A friend then arrived upon the scene and as unfortunately neither of us was able to sit up, we, with the consent of the man's relatives, poisoned the corpse with strychnine (we could not allow such a danger to our labour to live) and carried it through a dark, gloomy ravine. It was nearly dark by now and following the tiger's tracks with our gruesome burden in that eerie light was jumpy work and when a monitor rushed off through the dry leaves my heart stood still! At last we left the corpse at a spot near water. Next morning an old, almost toothless panther was found dead and the tiger had also eaten and rolled about, but had vomited and cleared off. He was seen the



next day crossing a grass hill. Since then there have been no human kills (possibly his painful experience of the poison deterred him from further experiments?) and this was the first one on record in the last 50 years or so. (Man-eating tigers, Journal of the Bombay Natural History Society, Volume 32, Issue 4, 1927).

A few years previously, A.P. Kinloch had contributed a note on the identity of the 'Devil Bird' of south India. In most planting districts of southern India, residents were familiar with a certain horrible nocturnal calls. These were described as screams and as 'diabolical blood-curdling shrieks as of a woman being strangled'. The calls, it was suspected, were made by a bird, which was referred to as the Devil Bird. Circumstantially, they were attributed to an owl, the Forest Eagle-Owl. But the Devil Bird's true identity was never proved. Indeed, it remains unproven to this day.

Kinloch had heard the Devil Bird's calls in the Nelliampathies. He noted that they were heard only between the months of November and February or March - the breeding season of the bird. On a number of occasions, he tried to shoot one when it was 'emitting its painful howls'. But he was never successful in obtaining a specimen to determine its identity. Then one day a labourer brought him an injured Brown Wood Owl, a bird different from the Forest Eagle-Owl. But when the labourer was carrying it, the Brown Wood Owl uttered a weak but unmistakable call - the call of the Devil Bird.

'Of course, I do not claim that this episode definitely establishes the identity of the "Devil Bird", wrote Kinloch, 'the similarity of the cries may have been fortuitous, but I think it probable that the identity of the "Devil Bird" is the Brown Wood Owl. A definite and final identification would be of interest.'

The Kinlochs found the Leopard Cat to be the commonest of the wild cats in the Nelliampathies. As its name suggests, this animal is a cat, but in appearance it resembles a miniature leopard. One day a labourer found a Leopard Cat with two kittens. He managed to catch one of the kittens, which he brought to the Kinlochs. Mrs. Kinloch reared the baby, feeding it with cow's milk. It became very tame and was allowed freely about the house and garden. But the domestic cats of their friend from the neighbouring estate did not tolerate her, and eventually the Leopard Cat left for the wild.

THE NELLIAMPATHIES REVISITED

I went on a second visit to the Nelliampathies recently with some friends. This time we took the adventurous alternative of trekking into the Nelliampathies from Parambikulam, on the south. This was possible thanks to one of us who obtained the requisite permission from the Kerala Forest Department.



WHEN WE REACHED OUR QUARTERS FOR THE NIGHT NEAR THE PARAMBIKULAM DAM, WE SAW WILD BOARS BY THE ROAD. EVIDENTLY, THEY HAD LEARNT THAT HUMANS MEANT A GOOD SUPPLY OF FOOD, AND HAD BECOME FAMILIAR WITH MAN.

The entry into Parambikulam had an exciting moment. It was that part of the year when many of the forest trees shed their leaves, and so the visibility was good. As we drove along a bend in the road, we saw a dark shape on the slope ahead. Very soon it was evident that it was a Sloth Bear out in the open!

A Sloth Bear is one of those wild animals that should be given a particularly wide berth. One should keep a certain distance in general when viewing wild animals. This is to avoid disturbing them. Additionally, in the case

of the larger animals particularly, there is an element of risk to humans: even if they are not malevolent by nature, they may cause injuries unintentionally, such as if they bolt in panic, simply on account of their size. Sloth Bears are unpredictable. In the safety of our car, we were in no danger of course. This particular bear bolted back into some bushes on seeing the vehicle. Crouching low, it regarded us, its long black fur shining. We drove on.

When we reached our quarters for the night near the Parambikulam dam, we saw Wild Boars by the road. What was surprising was that they were wandering about in the small settlement there as though they were domestic pigs! Evidently, they had learnt that humans meant a good supply of food, and had become familiar with man. Some of the larger boars sported tusks that protruded from their mouths. We learnt that they were given to chasing humans occasionally. Many of them were sleeping close to each other in little depressions they had dug in the dirt, looking like a set of small rocks on the ground.

As the sun set, we walked down to the reservoir. There at the water's edge, a pair of jungle fowl was foraging. A slight wind created waves that washed the shore, and small groups of cormorants,

looking like both crows and ducks, flew low over the water. There was a gibbous moon in the sky as we walked back. We heard the strange yelping calls of Jerdon's Nightjars around us. These birds were beginning their day, and soon we could see them wheeling in the sky, long winged and long tailed, hawking for insects.

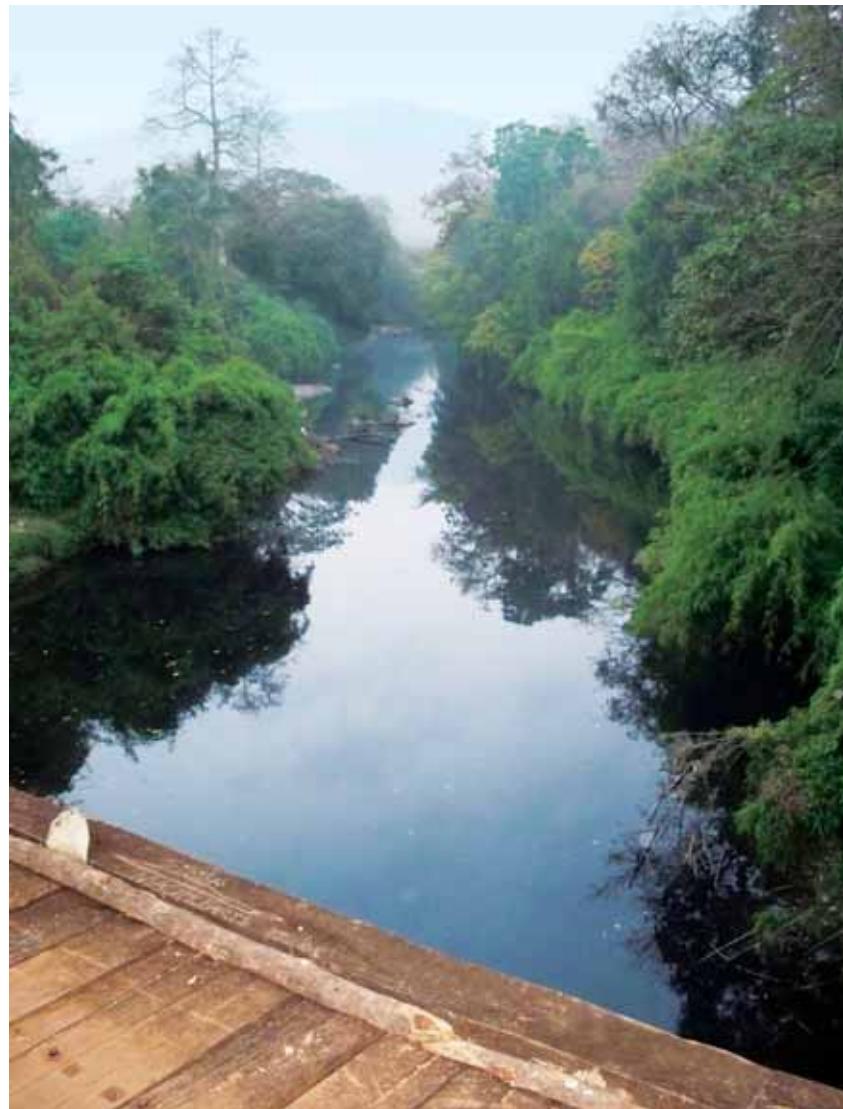
The next day we left at dawn by jeep, for the tribal settlement of Kuriarkutty. Driving through the dirt track of the forest we could see the bare trees against the dim light of the sky, and as we drove along, the dry leaves on the ground bounced along, rustling, in our wake.

Kuriarkutty was the archetypal tribal settlement in the forest by a stream. We had a quick breakfast at a hut with a thatched roof and bamboo benches and tables. There was much bird activity at a large tree by the stream. There were barbets, green and decorated with white facial marks, gathering berries. Scarlet Minivets were twittering at the treetop. The males were like animated flames, orange and black, while the females were replicas with yellow replacing the orange in their plumage. A large Storkbilled Kingfisher was perched above the stream, watching for prey. An occasional cackling and rollicking laugh broke out: there were Malabar Grey Hornbills around. Occasionally these birds flew from one tree to another. It was remarkable how these birds, larger than crows, long tailed and large billed, disappeared in the foliage once they alighted. After watching the birds for some time, we began our trek.

The track sloped up and wound through dense jungle. Some of the trees were very tall, with straight trunks and no branches. Others had creepers wrapped all around them. As we proceeded, we could smell a variety of forest fragrances here and there. It was warm and humid in the forest even early in the day, and we were perspiring heavily soon.

We came across groups of Nilgiri Langurs, jet black monkeys with very long tails and grey ruffed faces. Occasionally they would utter their loud, panting alarm calls and bound from one tree to another. Their agility in the canopy was remarkable. In some groups, the langurs would peer at us from high above.

At one place, we heard a Nilgiri Langur call loudly and saw it jump into the next tree. We were wondering if it was announcing our presence to the forest community, when we saw what had caused it to call: a mongoose-sized, dark animal descended



KURIARKUTTY WAS THE ARCHETYPAL TRIBAL SETTLEMENT IN THE FOREST BY A STREAM. THERE WAS MUCH BIRD ACTIVITY AT A LARGE TREE BY THE STREAM. THERE WERE BARBETS, GREEN AND DECORATED WITH WHITE FACIAL MARKS, GATHERING BERRIES. SCARLET MINIVETS WERE TWITTERING AT THE TREETOP.





rapidly down the tree. It proceeded along the ground towards the path, and then we lost sight of it. I suspect that this animal was a Nilgiri Marten, a creature which is at home in the trees, hunting and eating small animals. Not seen often, it was a rare opportunity for us to have come so close to one.

Occasionally the path came out of the forest into the open, particularly where it crossed a stream. At the streams there was an abundance of insect life in the form of butterflies and dragonflies. In the open, it was quite hot as the day progressed. We continued walking, stopping whenever we came across something interesting. At one place our guides showed us a plant that the local people call the *aanaviratti* or 'elephant chaser'. The large leaves of this plant are equipped with thorns that inject a chemical into the flesh of any passing animal that brushes against it, resulting in severe pain that lasts for a long time.



Presently we heard human voices, and came across labourers clearing fire lines in a coffee estate. We had crossed from Parambikulam into the Nelliampathies. Our path wound now through the coffee bushes. These were covered with white blossoms, and the sweet smell of the flowers hung in the air. Rubber trees were planted among the coffee bushes, the latex collecting in small containers hung on the trunks.

We walked alternately through forest patches and coffee plantations. In the forests we heard the loud, droning calls of cicadas. At one point saw a Great Pied Hornbill. Its wings made a loud sound as it flew. Our trek ended shortly and a jeep took us to our accommodation. The forest, resounding with the calls of the cicadas, gave way to open tea-planted estates.



evergreen forest in the valley below. Here we sat to survey the scene. We learnt later that this place was called Thamburankadu.

The trees were closely spaced and clothed in red and green leaves. We could hear the calls of Giant Squirrels and various birds in the forest. The valley was ringed by mountainous slopes and ridges. The forest flowed on to some of these slopes, but in other parts the slopes were only grass covered. There were steep parts where the bare rock was visible. As we surveyed the scene, we found a small party of Gaur grazing on one of the ridges. These are the largest oxen in the world, but they were so far away that their true size could not be appreciated. The light bases of their horns and their white 'stockings' stood in contrast to their dark brown and black general colour. On a more distant, steep and rocky slope, a couple of dots moved - Nilgiri Tahrs! These are highly endangered wild goats found nowhere else except in parts of the Western Ghats. They live on the most inaccessible and steepest cliffs. We reflected on the enchantment of the moment - the vantage point, the vibrant forest below, the Gaur on the crest and the Tahrs on the slopes.

In the night we went on a jeep ride along the track on which we had come to the hotel. The full moon was up, making the sky bright and creating silhouettes of the trees. Frogs and crickets called loudly. At one place we heard the faint crow-like calls of a flying squirrel. We saw few animals, but the experience of the moonlit forest was memorable.

The next morning we walked along the road and found a promising track leading off from it. There were many birds around. The Red-whiskered Bulbuls were everywhere, filling the air with their liquid warbling. The Scimitar Babblers called *Wot ho ho* calls around us. A dapper Black-winged Kite was perched on a treetop. Soon we found ourselves in open grassland, with a rock which presented an excellent view of an



We had to tear ourselves off from Thamburankadu. Near the hotel itself there were trees in which we found Giant Squirrels with luxurious maroon, black and white coats. There were also Bonnet Macaques by the roadside. The latter are

**ON A MORE DISTANT, STEEP AND ROCKY SLOPE,
A COUPLE OF DOTS MOVED - **NILGIRI TAHRS!**
THESE ARE HIGHLY ENDANGERED WILD GOATS
FOUND NOWHERE ELSE EXCEPT IN PARTS OF THE
WESTERN GHATS.**





to be seen even around human habitations in the plains, but here they were so healthy that their coats gleamed bright.

One of the places we visited was Seethargundi Estate, where a grand view of the plains is to be had. On the way we found a group of people watching something with great excitement, just off the road. A wild elephant, a tusker, was the object of their interest. The animal had wandered from the forest through a tea estate. The people were making so much

noise and approaching the elephant so closely that it seemed very surprising that it did not get irritated and attack them.

Kesavanpara was another viewing point we visited. On the way up we saw a green Calotes lizard on the ground. It was marked with light bluish streaks, which made it quite striking in appearance. It was surprisingly tolerant of our close approach. We reached a stretch of bare rock that appeared to have been scored with a giant comb. Here we had another extraordinary view of the plains below.

ONE OF THE PLACES WE VISITED WAS SEETHARGUNDU ESTATE, WHERE A GRAND VIEW OF THE PLAINS IS TO BE HAD. KESAVANPARA WAS ANOTHER VIEWING POINT WE VISITED.





The large Pothundy Reservoir stood out prominently and, as in Thamburankadu, there was a forest below. While we sat on the hot rock wondering what we would find here, a falcon came flying near a cliff. As quickly as it appeared, the falcon went out of view, but another bird of prey came into view. It had a black 'cap' and a white throat with a rusty belly and broad wings that had light patches on them. This was a Rufous-bellied Hawk Eagle, a bird of the forest not seen commonly - and a birdwatcher's delight! As we watched, the Rufous-bellied Hawk Eagle soared into the sky and disappeared from the view, sizzling like a dot into the blue.

THE TIMELESS NELLIAMPATHIES

The pressures of the 21st century have been felt in many parts of the Western Ghats. One grows apprehensive about the effects of these pressures on the Nelliampathy Hills. Hotels have come up in the hills. The number of people living has probably increased, with the number of visitors surely increasing. And the reservoirs that can be seen from the vantage points were not here when the Kinlochs were planters, for sure. But little else seems to have changed. Even the names of the estates have changed little in nearly a hundred years.

The accounts of the Kinlochs and our own observations match uncannily. The Gaur was here even in the 1920s. 'Most shikar books emphasize the extreme aversion bison [Gaur] evince for the proximity of man', wrote A.P. Kinloch. 'There is an estate near here with a grass-jungle-topped hill rising about 400 feet behind





THE NUMBER OF PEOPLE LIVING HAS PROBABLY INCREASED, WITH THE NUMBER OF VISITORS SURELY INCREASING. AND THE RESERVOIRS THAT CAN BE SEEN FROM THE VANTAGE POINTS WERE NOT HERE WHEN THE KINLOCHS WERE PLANTERS, FOR SURE. BUT LITTLE ELSE SEEMS TO HAVE CHANGED. EVEN THE NAMES OF THE ESTATES HAVE CHANGED LITTLE IN NEARLY A HUNDRED YEARS.

the bungalow... This hill is the favourite resort of what my friend, the owner of the estate, calls his 'tame herd' and which he never molests. They constantly come out on that hill, usually in the early morning, and graze till about 9 a.m.'

The Tahr were there too. They were common then and our observations suggest that they are 'common' here even now. The elephant was then 'a perfect pest...throughout the dry months'. A.P. Kinloch wrote that every planter on the hills had been chased at least once by the elephants. This is probably true even today, judging by what we saw! Nilgiri Langurs, Nilgiri Martens, Bonnet Monkeys, Flying Squirrels, they had all been found in the Nelliampathies during the Kinlochs' time, and they continue to thrive there. Giant Hornbills, Scarlet Minivets and Scimitar Babblers too have been present in the Nelliampathies for a very long time. There have even been Nilgiri House Swallows nesting under the leaves from the time of the first planters.

Time has stood still in the Nelliampathies. The lack of change and the continued presence of the wildlife affords satisfaction and reassurance. The proximity of wildlife to human settlements gives one hope for the future of biodiversity on the planet itself.



Roll

of

the

PRESSE

COMPRESSORS IN OFFSET PRINTING

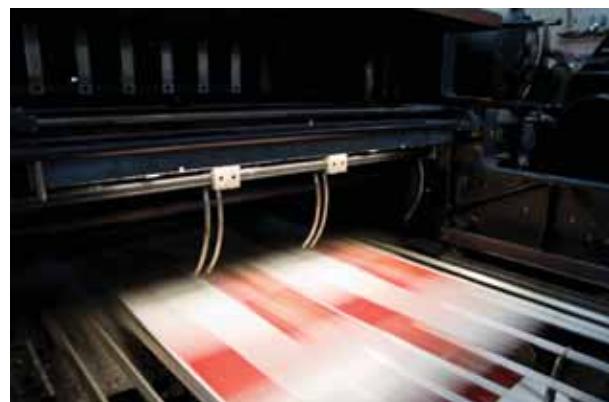




A COMPLEX PIECE OF MACHINERY

It is fascinating to watch a modern offset press – a large piece of machinery, almost an assembly line in itself – in operation. Blank or partially printed paper, cardboard or other medium awaits processing at one end. When the machine begins to work, the medium passes through a series of large rollers successively. By the time the medium emerges from the final roller, it has transformed into pages of a book, into a carton ready to be folded or into a poster. The choice of colours and the layout of the components on the finished product are restricted only by human imagination.

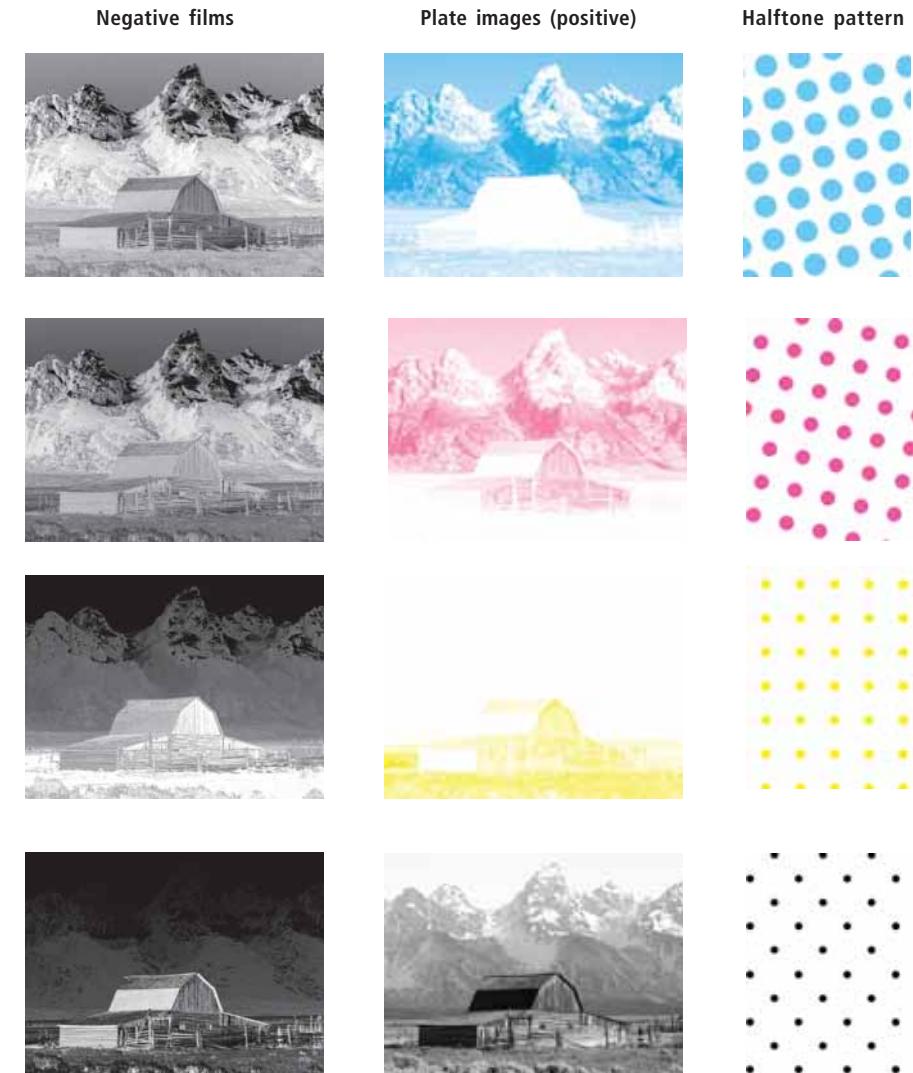
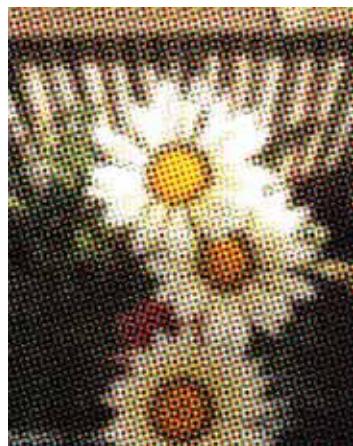
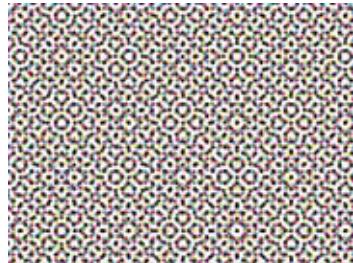
This intricate piece of machinery is provided with a large and impressive control panel of knobs, switches and digital displays. The press and the control panel are typically housed in a hall reminiscent of a neat factory. Somewhere in the hall is an air compressor, supporting the operation of this giant machine.



Elgi equipment used by the printing industry

Both reciprocating and rotary air compressors are used in printing presses. These compressors fall within the 7.5 to 20 hp, 20 to 55 cfm range. Elgi makes a wide range of compressors with these capacities. These machines are normally used with driers and oil-removing filters.

(top): The **rosette** pattern of CMYK dots
(down): The dots merging to form the image

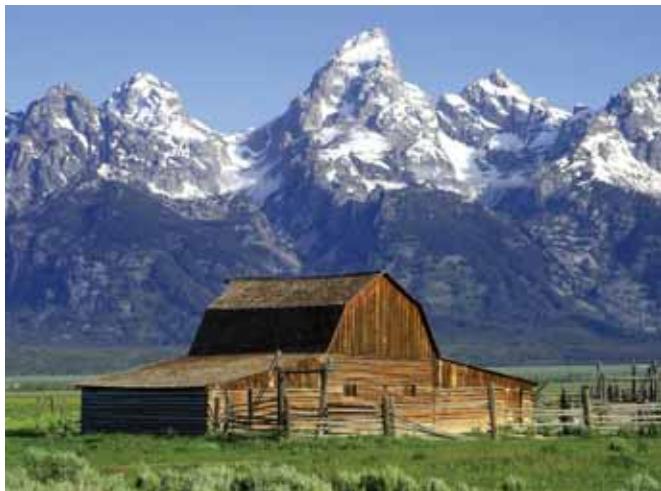


The best known offset presses are manufactured in Germany and Japan. Just as the presses are large, complex and versatile, so are they expensive. A reputed model may cost as much as 3.5 crore rupees.

When the machine is switched on, the motors begin to hum and pick up speed, as though a jet aircraft is preparing to take off. The paper (or other material) is fed into the rollers, one by one if it is in the form of cut sheets. The printing medium can alternatively be a long and continuous sheet, as though it were some enormous roll of tissue paper. It is then known as a web. It goes into one roller and emerges before the mind has time to register the fact. It then goes into the next roller and so on, and is out in a trice. The supply of raw material diminishes rapidly at the one end, and the printed material accumulates at the other with impressive rapidity.

The rollers are of course where the actual printing takes place. The colours are printed one at a time and not all together. Any colour is 'created' by juxtaposing tiny dots of 'primary colours', and the printing process consists of printing dots of just these primary colours in sequence. These colours happen to be cyan, magenta, yellow and black, CMYK for short.

For printing each of the colours, a 'plate' is created of the image that is to be printed. Thus for any page of say, *Elgi Magazine*, which typically has multi-colour illustrations and text, four plates are created digitally. These are created by the offset printer from a page that has been provided by the compositor. There is one plate each for cyan, magenta, yellow and black. A plate is actually a plastic film with a 'negative' of the image on it, but when it is mounted on a roller, it is indeed fixed on a metal sheet or plate.



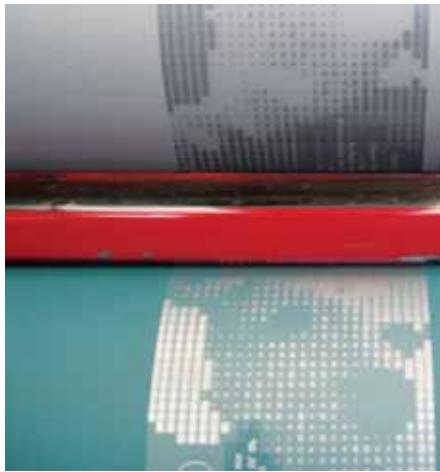
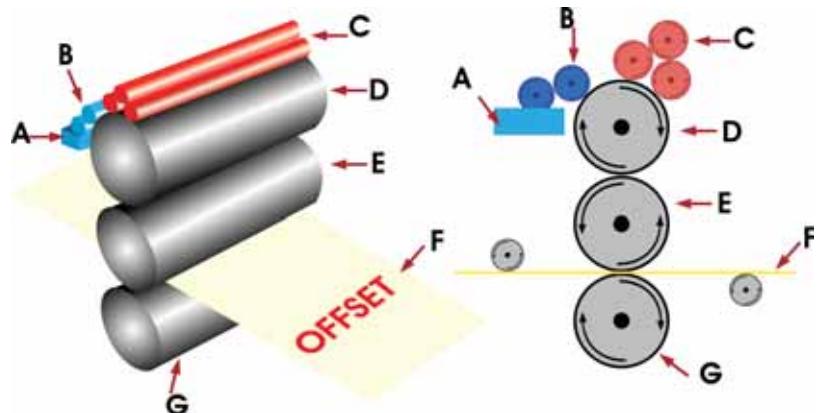


Plate cylinder and Impression cylinder

ANY COLOUR IS 'CREATED' BY JUXTAPOSING TINY DOTS OF 'PRIMARY COLOURS', AND THE PRINTING PROCESS CONSISTS OF PRINTING DOTS OF JUST THESE PRIMARY COLOURS IN SEQUENCE. THESE COLOURS HAPPEN TO BE **CYAN, MAGENTA, YELLOW AND BLACK, CMYK** FOR SHORT.



**A- Water Reservoir, B- Water Rollers
C- Ink Rollers, D- Plate Cylinder
E- Blanket Cylinder, F- Paper
G- Impression Cylinder**

INVENTION OF THE OFFSET PRESS

The offset press was invented in 1875 by Robert Barclay of England, for printing on tin. In 1903, Ira Washington Rubel of the United States developed a modified version for printing on paper. The offset technique employs a planographic (flat) image carrier on which the image to be printed obtains ink from ink-rollers while the non-printing area attracts a water-based film keeping it (the non-printing area) ink-free.

COMPRESSED AIR IN A PRESS

- When the paper is continuous (a web) as in newspaper printing, its tension is controlled pneumatically. Changing the paper reel is also controlled by a pneumatic cylinder.
- All the printing functions, such as turning the inking rollers on or off, are carried out using pneumatic cylinders operated by compressed air.
- An air cushion is provided to minimise friction between the rollers and the printed web.
- Air cushioning is provided again while folding the printed paper so that the printing is smudge free.

Brochures, books, newspapers and magazines are all now mostly printed using the technique of offset printing. They feed the reading requirements of a voracious public, which in 2005 consumed 45 trillion pages, notwithstanding claims for its attention from television, the Internet and other competitors.

But reading was not always the common habit that it is now. It was simply because books were not commonly available then and the reason for this of course was that printing presses had not been developed.

BEFORE THE PRESS

The following printing techniques were in use before offset printing was developed:

Stencils: Stencils have been used on cloth for a very long time. Natural colours derived from plants and flowers were originally used. Stencils could be used for mass production.



Woodblock printing: This is one of the oldest printing technologies, and it has been used throughout the world. It originated in China for printing on textiles and

paper. Tri-colour flowers were printed on silk during the Han dynasty. Excavations in Mesopotamia have yielded clay tablets featuring complex and beautiful images which might have been used for block printing. In the Islamic world, print blocks were made of wood, metals such as tin, lead and cast iron, as well as stone, glass and clay. Block printing was developed in Arabic Egypt during the 9th and 10th centuries. Printing on cloth was common in Christian Europe by 1300. Printing on paper started there around 1400.



Movable type: This is a system of printing and typography using movable pieces of metal type. Movable type page-setting was much quicker and more durable than woodblock printing. Though the first known movable type system was created in China during 1040, the German inventor Johannes Gutenberg is credited with the invention of the movable type printing technology around 1439. Gutenberg, a goldsmith by profession, was helped by Johann Fust and Peter Schoeffer. He replaced previously used water-based inks with oil-based inks. He made his type from type metal, which is an alloy of lead, tin and antimony. Type metal is also known as printer's lead or the printer's metal. Gutenberg's invention is today considered the most important invention of the second millennium.

Flat-bed printing press: A flat-bed printing press is a mechanical device for applying pressure to an inked surface resting upon a medium, thereby transferring an image. The first such system was assembled in the mid-15th century in Germany by Gutenberg. It was an excellent method of creating reproductions for mass consumption. Soon, many printing houses cropped up. They were run by 'master printers' who employed print shop apprentices, journeymen printers, compositors and pressmen. Some master printing houses became the cultural centres for literati.

TYPE METAL IS ALSO KNOWN AS PRINTER'S LEAD OR THE PRINTER'S METAL. GUTENBERG'S INVENTION IS TODAY CONSIDERED THE MOST IMPORTANT INVENTION OF THE SECOND MILLENIUM.

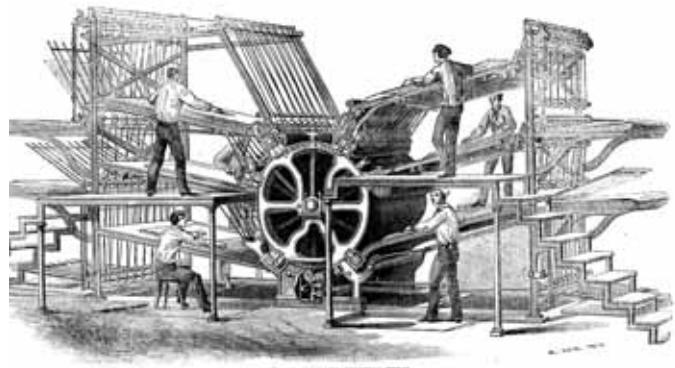


Rotary printing press: Richard March Hoe invented rotary drum printing in 1847. William Bullock brought about improvisations on this invention in 1863. A rotary printing press is one in which the impressions are laid around a cylinder. This enables printing long, continuous rolls of paper, cardboard and plastic.

Lithography: This method for printing on a smooth surface was invented in 1796. Here chemical processes are used to create an image. The positive part of an image is a hydrophobic chemical while the negative image is water. Most books are today printed using offset lithography. Mass-produced items which have print and graphics on them (including posters, maps, books, newspapers and packaging) are produced using lithography. Offset lithography depends on photographic processes.

The first method of making true multi-colour prints was chromolithography. It replaced colouring prints by hand.

Screen printing: Simple stencilling, especially the Japanese form called *katazome*, gave birth to screen printing. Samuel Simon obtained the first patent for screen printing in England in 1907. In 1914 John Pilsworth of California used screen printing to form multi-colour prints.



(top left):
A woodblock,
Movable type
(center):
Gutenberg's flat bed press
(bottom right):
Rotary printing press,
Screen printing process

SOME MODERN PRINTING TECHNIQUES

Flexography

Flexography, also called surface printing, is a method commonly used for labels, boxes, bags and banners.

Photocopying

Xerographic office photocopying introduced by Xerox in the 1960s almost rendered obsolete the carbon paper, mimeograph machines and other duplicating machines.

Thermal printing

The thermal printer uses a thermochromic paper (thermal paper, for short) which is passed over a thermal print head. The paper is selectively heated, and the coating turns black in the heated areas, thus producing an image.

Laser printer

The laser printer was invented at Xerox in 1969 by researcher Gary Starkweather. It is in fact a modified xerographic copier. The IBM model 3800, introduced in 1976, was the first laser printer. The model was used for high-volume printing of documents. It is in use even today in spite of all the latest developments and improvisations.

The Xerox Star 8010, released in 1981, was the first laser printer designed for use with an individual computer. The laser printer had an important role in popularizing desktop publishing since documents could be created without resorting to professional typesetting. Laser printing eventually turned out to be a multi-billion dollar business for Xerox.

Dot matrix printing

A dot matrix printer is also called an impact matrix printer. It works very much like a typewriter. A print head moves to and from over the page, and prints are created by impact. Varied fonts and arbitrary graphics can be produced.

Ink jet printing

This computer printer operates by propelling tiny droplets of liquid ink onto paper.

Dye sublimation printing

A dye sublimation printer is also a computer printer. The printing process uses heat to transfer dye to a medium such as plastic card, printer paper or poster card.

3D printing

3D printing uses the rapid prototyping technology. It is a method of converting a virtual three-dimensional model into a physical object. Successive layers are printed on top of the previous one to build a three-dimensional object.



Before printing became widespread, the ability to read had been restricted to groups such as the clergy. Churchmen and governments were concerned that print undermined the mediation by authorities of thinking, allowing readers, from all classes of society, to study religious texts and politically sensitive issues. Not only was religion affected by printing, the reverse was true as well. Reading was even considered a dangerous pursuit because it was seen as rebellious and unsociable.

Hebrew printing developed in Italy, beginning in Rome in 1470 and subsequently spreading to other towns, because Jews were banned from German printing guilds. Italy was the source of books in a non-local language again, this time Arabic, more than a century later. Printing, particularly in Turkish or Arabic, had been opposed strongly before then. It is believed that this opposition to printing in the Muslim world had prevented the spread of printing from China to the West previously. Printing by Turks of religious books was considered a sin and was punishable by death. At the end of the sixteenth century the sale of non-religious printed books was permitted in Turkey, but most were imported from Italy.

Printing was not exactly afforded a warm welcome in different parts of the world. It took a long time to penetrate the Orthodox Christian regions of Russia and modern Bulgaria, Romania and Serbia. When a press was brought to Moscow in 1564, a mob destroyed the workshop. In England, around this time, most books were of a religious nature. The content was regulated by the church and the king. Overstepping the limits imposed by law could lead to harsh consequences. One William Carter printed a pamphlet in support of Catholicism in the Protestant-dominated country. As a result he was hanged. It was said of the widespread distribution of the Bible that it 'had a revolutionary impact, because it decreased the power of the Catholic Church as the prime possessor and interpreter of God's word'.

A WEALTH OF CHANGES

By the middle of the seventeenth century, there was enthusiastic support for printing, such as from Samuel Hartlib, who wrote this in 1641: 'the art of printing will so spread knowledge that the common people, knowing their rights and liberties, will not be governed by way of oppression'. Printing brought about

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occupational changes as it spread. Literacy was essential for printers, who were a new group of artisans. The occupation of scribes, whose work was more labour-intensive, declined. Proof-correction was another new occupation. The number of book sellers and librarians grew along with the number of books.

Scholarly analyses of the impacts of printing point out that the introduction of the printing press led to the decline of an oral culture. Before the printing press, reading was usually a group event in which one person read to a group of people. As literacy and the availability of books grew, reading became a solitary pursuit. Previous reading involved reading of texts intensively from start to finish. This changed, and people began reading on particular topics or chapters. Reading also became critical in that people could form their own opinions on texts because these became readily accessible.

Print enabled new generations to build on the intellectual achievements of older ones. It created a uniform, sustained

reference for knowledge and allowed comparisons between incompatible views. As one historian expressed in 1895, print gave 'assurance that the work of the Renaissance would last, that what was written would be accessible to all, that such an occultation of knowledge and ideas as had depressed the Middle Ages would never recur, that not an idea would be lost.'

A NIGHTMARE: A BLANK DREAM

Imagine you have a dream. Everything in this dream is blank or plain. The sheets and the curtains are plain. The calendar on the wall is a set of blank sheets. The books are blank, and so are the newspapers and magazines. The shopping bags, cartons and milk packets are all plain. There is no printing.

What a nightmare! Or as the French put it, *Quel cauchemar!*

Fortunately, it is only a nightmare. But it serves to remind us of what we take for granted.

The art of printing has affected human society, religion and intellectual development. The thought of returning to pre-printing days is unbearable.

Print has also added colour to our world. If it wasn't for the art of printing, our existence would indeed be one filled with drab, colourless artefacts.





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Down the DRAIN

COMPRESSORS IN
WASTEWATER TREATMENT



Waterbirds are among the easiest birds to observe - in fact they practically call out to be noticed. These birds mostly frequent open stretches of water which have hardly any obstructions. Here they stand out against the water. Sometimes waterbirds are found in unlikely looking urban situations, where they turn up in large numbers. Even as individuals, they may be eye-catching if they are large in size or brightly coloured. Remarkable looking flamingos, pink, long-necked and long-legged, are regularly seen in Sewri, in Bombay (or Mumbai). Pelicans, which are among the largest birds capable of flight and are provided with extraordinarily large and extensible bills, have been seen in recent years in the Pallikaranai marshes of Madras (or Chennai), along with thousands of other waterbirds.

Now, it goes without saying, that these large cities with intense human activity have water courses that are polluted. Why then do birds such as pelicans, flamingos and other birds congregate here? The reason for their being there is that there is food in the water. Fish, worms, snails and other aquatic creatures, as well as water plants such as algae and reeds, are found abundantly, and they draw these birds. In fact, an entire food web flourishes in the water. And supporting this food web is unappealing material of mineral and biological origin in the water. The waters that the birds flock to in may, strictly speaking, be bodies of wastewater.



THE TERM WASTEWATER REFERS TO ANY WATER THAT CONTAINS POLLUTANTS AS A RESULT OF HUMAN ACTIVITIES. WASTEWATER PRODUCED BY INDUSTRIES IS KNOWN AS **INDUSTRIAL WASTEWATER**, WHILE THAT FROM RESIDENCES AND COMMERCIAL INSTITUTIONS IS CALLED **DOMESTIC WASTEWATER**.

WASTEWATER AND ITS TREATMENT

Corresponding to the vast quantities of water human beings collectively consume, they produce large amounts of wastewater. The term wastewater refers to any water that contains pollutants as a result of human activity. The pollutants cause the wastewater to have undesirable qualities such as colour, odour, turbidity and the presence of pathogens. Wastewater produced by industries is known as industrial wastewater, while that from residences and commercial institutions is called domestic wastewater. Normally the sanitary sewers in a city carry a combination of these wastewaters, and this combination is referred to as municipal wastewater. The word *sewage* is sometimes used as a synonym for *wastewater*, but it is more correct to use it for wastewater from residences only. Precipitation runoff, or rainwater, is usually carried in storm drains

that are not connected to the sewer system, but a small portion of the runoff tends to leak or infiltrate into the sewers.

Whereas municipal wastewater can sometimes be friendly to birds and other life, without treatment it is usually otherwise. Laws in most countries prohibit the discharge of untreated wastewater directly into rivers, lakes or oceans as it can lead to many problems. Nature simply cannot 'handle' many of the contents of wastewater. Toxic chemicals can kill or cause genetic defects in aquatic life. Heavy metals such as mercury accumulate in fish and affect the health of human beings who consume the fish. Pathogens cause illnesses when the water is used for recreational activities such as swimming. In addition, if the pathogens enter a city's water supply





which is not adequately treated, mass outbreaks of illnesses can occur. The outbreak of *Cryptosporidium* in Milwaukee, USA in 1993, which sickened 400,000 residents and led to the death of over 100, was possibly due to the contamination of drinking water by sewage.

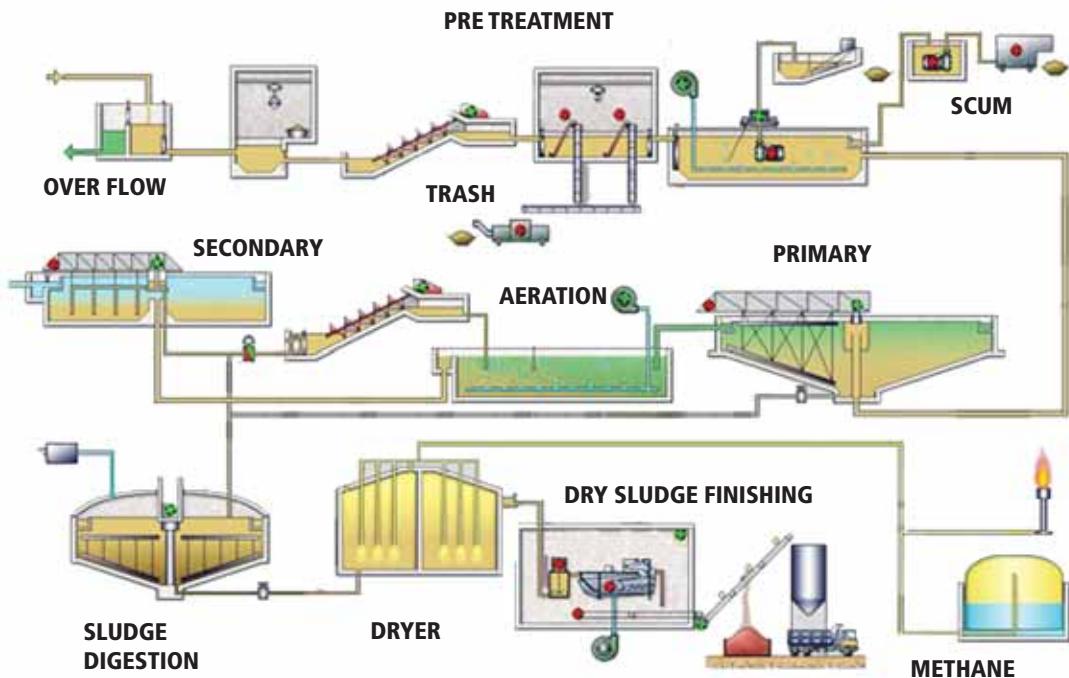
Organic materials serve as nutrients for bacteria, which consume the dissolved oxygen in receiving streams, and reduce their ability to support aquatic life. Other organic materials containing nitrogen cause excessive growth of algae and plankton. This process is called eutrophication and leads to the inability of the water to support higher plants and animals due to oxygen depletion. Wastewater must be treated to reduce the level of pollutants to within acceptable limits. Statutory bodies such as the Environmental Protection Agency (EPA) in the USA and the Central Pollution Control Board (CPCB) in India set the maximum allowable levels of various pollutants in the effluent from wastewater treatment plants. When designing a municipal treatment plant, it is necessary to identify the types and amounts of pollutants present in that particular location.

One major classification of pollutants is as total suspended solids (TSS) and total dissolved solids (TDS). TSS consists of sand, silt and organic matter. Another classification is as organic components and inorganic components. Organic components are carbon-based and may be of plant or animal origin. Inorganic components are all made up of other elements and compounds. Dissolved inorganic components may be distinguished as toxic

and nontoxic chemicals. The most common toxic inorganic chemicals in municipal wastewater are cyanides, asbestos and 13 metals including chromium, lead and mercury. Metals are not biodegradable. Nontoxic inorganic chemicals are important because they alter chemical properties of wastewater such as acidity or alkalinity and salinity. These properties could affect the ability of microbes to consume the organic material in the wastewater. The presence of nontoxic dissolved inorganic chemicals could also affect the ability of the treated wastewater to be reused.

Organic materials in wastewater are very important because they are a major component and because they form the nutrients in biological treatment processes. They are a mixture of many different carbon-containing compounds, and so the tests to measure them





PROCESSES THAT USE ONLY PHYSICAL METHODS ARE CALLED UNIT OPERATIONS (UO) WHILE THOSE THAT USE CHEMICAL OR BIOLOGICAL METHODS ARE CALLED UNIT PROCESSES (UP). MUNICIPAL TREATMENT PLANTS USE A COMBINATION OF THESE PROCESSES IN A SERIES TO OBTAIN THE DESIRED EFFLUENT QUALITY.

are non-specific. The three most commonly used tests are total organic carbon (TOC), chemical oxygen demand (COD) and biochemical oxygen demand (BOD). BOD is a measure of the oxygen required by microorganisms to oxidize the organic material present and is therefore a measure of the biodegradable organic matter present.

Municipal wastewater treatment plants are usually found in and around cities and treat the combined wastewaters from various sources. In rural areas, individual homes use septic tanks, which are also called on-site sewage facilities. Many industries, such as chemical plants, paper plants, tanneries and petroleum plants, produce complex wastes that are difficult to treat in large quantities. Such industries must also have on-site facilities to treat their wastewater, which they cannot send directly to a municipal treatment plant. As a result they are also able to recover some chemicals and reuse the treated water.

There are many processes that can be used to remove pollutants from wastewater, and these involve physical, chemical or biological methods. Processes that use only physical methods are called unit operations (UO) while those that use chemical or biological methods are called unit processes (UP). Municipal treatment plants use a combination of these processes in a series to obtain the desired effluent quality. They always contain primary and secondary

treatment stages, while a tertiary treatment stage may be present if a higher-quality effluent is desired.

PRIMARY TREATMENT

Screening (UO): Screening is usually the first step at a wastewater treatment plant, and as the name suggests, it uses screens to remove material. Coarse screens are used to remove large objects such as cans, bottles and sheets of paper which are not biodegradable and which could damage equipment.

Flow equalization: This is actually not a treatment process at all. It is a means of keeping the influent flow rate steady, as well as averaging the BOD level. Flow equalization involves the use of a basin in which the wastewater is stored and provided with adequate aeration and mixing (to prevent odour formation and sedimentation).

Sedimentation (UO): Sedimentation is used to remove suspended solids by means of gravity settling. The influent is fed into large rectangular or circular basins under quiet flow conditions, and the solids that settle at the bottom are mechanically collected and sent for sludge processing. Liquids that are lighter than water, such as oil, are skimmed from the surface.

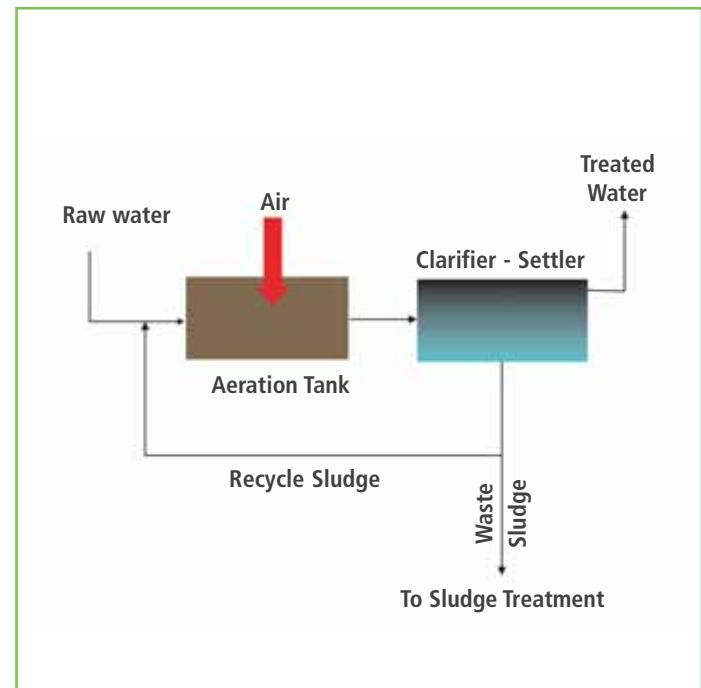
SECONDARY TREATMENT

Biological waste treatment: While primary treatment removes solids that settle, secondary treatment involves removal of dissolved and suspended organic material, by biological treatment processes. There are many types of microorganisms present in the culture used, but it is bacteria that consume a majority of the organic matter. The bacteria first assimilate the organic matter and then metabolize them into carbon dioxide and water.

Suspended growth treatment processes are those in which the microorganisms remain suspended in the wastewater. They include the activated sludge process and treatment ponds. In attached growth treatment processes the microorganisms are bound to a solid medium and remove nutrients as wastewater flows over them. Examples of attached growth processes include trickling filters and rotating biological contactors.

Activated sludge process (UP): The activated sludge process is the most commonly used secondary treatment process in medium and large municipal treatment plants. “Activated sludge” refers to the microbial culture that assimilates and metabolizes organic matter as it is agitated by air in the aeration tank. The microorganisms flocculate as they grow and multiply, and can be separated in a secondary clarifier that is placed after the aeration chamber. Part of the sludge is returned to the aeration chamber to continue the process. Air is supplied to the aeration tank by diffusion or mechanical aeration. In diffused aeration, compressed air is sent through nozzles or pipes with small holes, placed at the bottom of the tank. Mechanical aeration is achieved using surface impellers or submerged turbines.

Treatment ponds and aerated lagoons (UP): Treatment ponds have been in use for many years, but can only service small communities. All treatment ponds are forms of biological wastewater treatment, but they work quite differently based on their depth and dissolved oxygen content. Aerobic ponds are shallow ponds containing aerobic bacteria and algae where the sunlight penetrates to the bottom and dissolved oxygen is present throughout. Facultative ponds are deeper ponds which have an aerobic zone at the top, a facultative zone (containing bacteria that can survive with or without oxygen) in the middle, and an



AIR IS SUPPLIED TO THE AERATION TANK BY DIFFUSION OR MECHANICAL AERATION. IN DIFFUSED AERATION, COMPRESSED AIR IS SENT THROUGH NOZZLES OR PIPES WITH SMALL HOLES, PLACED AT THE BOTTOM OF THE TANK. MECHANICAL AERATION IS ACHIEVED USING SURFACE IMPELLERS OR SUBMERGED TURBINES.





WASTEWATER THAT IS STABILIZED BY SECONDARY TREATMENT IS CLEAN ENOUGH TO BE DISCHARGED INTO WATERWAYS. THE EFFLUENT MAY BE REUSED FOR PURPOSES SUCH AS DRINKING WATER, AGRICULTURE, NON-POTABLE WATER AND SO FORTH.

anaerobic zone at the bottom. Anaerobic ponds are deep ponds that receive a lot of organic matter, such that little or no dissolved oxygen is present throughout the entire depth. Aerated lagoons are ponds that are oxygenated by surface aeration or diffused air aeration.

Trickling filters (UP): A trickling filter consists of a shallow layer of stones, covered by a slime layer that contains the microorganisms. Wastewater is applied on the top and trickles through as the organic matter is removed from it. Oxygen for the process is provided by natural air circulation. The effluent contains biological solids which are separated in a secondary clarifier. Part of the flow is recirculated back to the trickling filter.

Rotating biological contactors (UP): A rotating biological contactor operates on the same principle as the trickling filter. It contains rotating discs that are covered by a layer of microorganisms. This process is said to be more efficient than the activated sludge process.

Nitrification/denitrification(UP): Conventional secondary treatment systems dealt only with the removal of organic matter from wastewater. Later it was found that nitrogen was also an important pollutant that could cause algal



blooms, and needed to be removed. A nitrification stage may be a separate stage or combined with suspended or attached growth treatment. It involves bacteria that convert nitrogen in the form of ammonia to nitrates. The nitrates can then be removed in a denitrification stage by facultative bacteria that convert them to nitrogen gas. A little methanol is added in this stage to provide nutrients for the denitrifying bacteria. Other means of nitrogen removal include ammonia stripping, breakpoint chlorination, and ion exchange.

Tertiary treatment (UO/UP): Wastewater that is stabilized by secondary treatment is clean enough to be discharged into waterways. The effluent may be reused for purposes such as drinking water,

agriculture, non-potable water and so forth. Depending on the use, a higher-quality water may be required. In such cases, tertiary treatment is performed by using processes such as filtration, carbon adsorption, reverse osmosis and electrodialysis.

Sludge digestion: Primary and secondary treatment processes produce a large amount of sludge. Sludge contains organic solids and water. Disposal of sludge is an important and expensive activity at treatment plants. The steps involved in sludge disposal are concentration, stabilization, conditioning, dewatering, drying and combustion. Stabilization or digestion may be carried out as an aerobic process or anaerobic process. Aerobic digestion is a continuation of the activated sludge process and results in less solid waste,



AIR COMPRESSORS CONNECTED TO TUBULAR DIFFUSERS PROVIDE DISSOLVED OXYGEN FOR MICROORGANISMS IN AN AERATION TANK. THEY OPERATE ALL VALVES AND ACTUATORS IN A WASTEWATER TREATMENT PLANT.

which can be easily dewatered. Anaerobic digestion produces methane gas, and an effluent that has a high concentration of organic material, but it is a cheaper process.

Compressed air finds a number of uses in the treatment of effluents and wastewater. Air compressors connected to tubular diffusers provide dissolved oxygen for microorganisms in an aeration tank. The dissolved air flotation process uses air at a high pressure to bring impurities to the surface, where they are skimmed. A belt filter press is used for dewatering sludge, and the belts are pneumatically controlled. Air compressors are used to operate all valves and actuators in a wastewater treatment plant.

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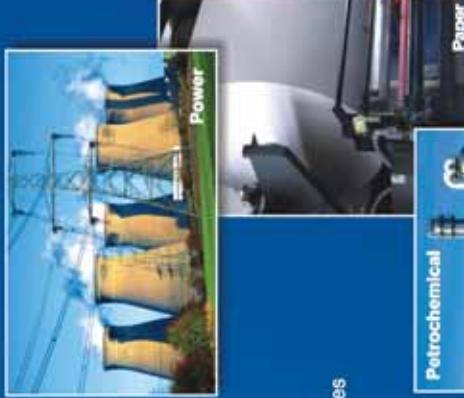
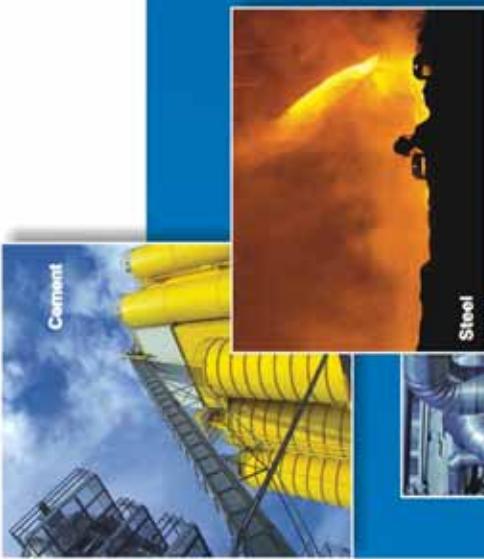
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COMPRESSORS IN LAMP MAKING

Lamps and

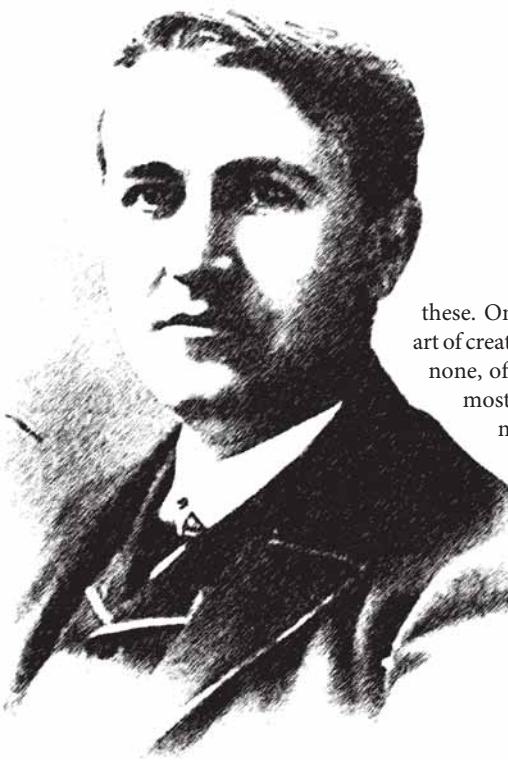
AIR

STICKS AND STONES

Many thousands of years ago, no human adults knew anything about electrons or atoms. As a matter of fact, they only just qualified for the appellation human because they were not really our species though they were very closely related to us. Whereas we belong to the species *Homo sapiens*, they were of *Homo erectus*. Regardless of whether you consider these people-animals 'us' or something else, there is evidence, in the form of heated clay, that even more than a million years ago, they had made a very significant discovery: they had learnt how to build fire.

How did the cave man build fire? We can guess that having understood its utility, when he came across a naturally started fire, such as a bush fire started by lightning, he brought it to his camp and kept it alive by feeding it leaves and sticks. Subsequently he might have observed sparks flying when he fashioned tools using stones. Recognising the sparks to be the seeds of full blown conflagrations, he might have persevered at raising flames from

FIRE ALLOWED
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these. Once he had mastered the art of creating a fire where there was none, of course, he had gained a most useful skill. For him, fire meant the availability of light in addition to heat.

Thus for countless years he struck away at stones and scrubbed sticks against each to produce fire and light, untroubled by notions of molecules and electronic energy levels.

Fire, supported by wood or by oil and other fuels, remained for a very long time the only means of obtaining light in the darkness. Fundamentally different methods of creating light would have to await the discovery of electricity.

THE FIRST COMMERCIAL BULB

Contrary to the popular notion, Thomas Edison was not the inventor of the first electric light bulb! Various inventors demonstrated lighting under laboratory conditions during the 1800s. Among these developers of electric lamps were Humphrey Davy, James Bowman Lindsay, William E. Sawyer and Joseph Swan. But their inventions drew too great an electric current or were too expensive to manufacture or were extremely short lived.

Edison put together the key features of these devices, introducing a high-resistance filament and a high vacuum in the bulb so that the lamp would last for hundreds of hours. As with most of Edison's other inventions, his lamp was an improvement over prior art. Edison's claim to fame is that he invented the first commercially practical incandescent light.

THE DEVELOPMENT OF THE BULB

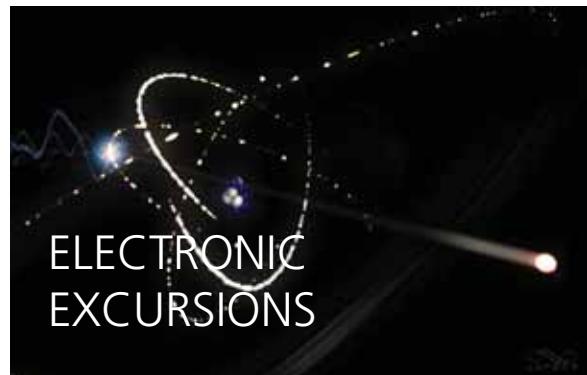
Thomas Edison is said to have bought the patent that Henry Woodward held for a bulb, which consisted of a carbon rod in a nitrogen filled glass cylinder. Actually this device was rather different from the bulb that Edison eventually invented. Edison formed a company, the Edison Electric Light Company, in 1878.

Initially he experimented with metal filaments including platinum and a carbon filament later on. In October 1879 he successfully tested a carbon filament lamp for 40 hours. He improved this continuously, and few months later he had developed a carbonized bamboo filament that could burn for more than 1200 hours.

On 31 December 1879, Edison demonstrated his incandescent light bulb in public for the first time, in Menlo Park. At this demonstration he is said to have said famously that "we will make electricity so cheap that only the rich will burn candles".



THOMAS EDISON WAS NOT THE INVENTOR OF THE FIRST ELECTRIC LIGHT BULB! EDISON'S CLAIM TO FAME IS THAT HE INVENTED THE FIRST COMMERCIALLY PRACTICAL INCANDESCENT LIGHT.



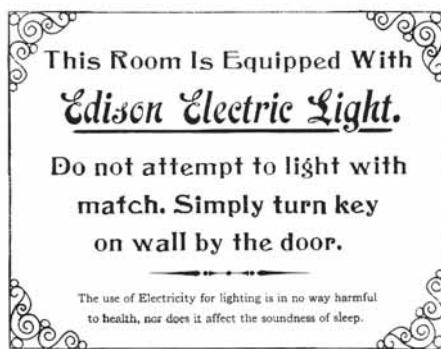
An atom is made of subatomic particles, the electrically charged protons and electrons and the neutral neutrons. The protons and the neutrons are held together tightly in a dense core known as the nucleus at the centre of the atom. The practically weightless (or massless, to be accurate) electrons move around this nucleus.

The electrons are rather mysterious objects, with one never being certain where exactly they are at a given point of time. They maintain a considerable distance from the nucleus. When an electron moves to a lower level it produces electromagnetic radiation, which could be anything from a relatively weak radio wave to very powerful X-rays, and everything else in between.

In fact, these excursions of electrons between energy levels are practically the only source of electromagnetic radiation such as visible light.

MANUFACTURE AND A WAR OF CURRENTS

Never one to sit back after inventing something, Edison had the ability to maximize profits through mass production. The person in charge of testing the incandescent electric lamp was William Hammer. In 1880 he was made the chief engineer of the Edison Lamp Works, and in the first year the plant produced 50,000 lamps. The first public building to use the lamps was the Mahen Theatre in Brno in today's Czech Republic. The first public building to use the lamps was the Mahen Theatre in Brno in today's Czech Republic.



A 'WAR OF CURRENTS' WAS ON TO PREVENT AC FROM BEING ADOPTED. EDISON WENT TO THE EXTENT OF ELECTROCUTING ANIMALS AND DEVELOPING THE ELECTRIC CHAIR TO DEMONSTRATE THE LETHAL POTENTIAL OF AC.

Edison also had to create a complete system for generating and distributing electricity. He patented an electricity distribution system so that he could capitalize on his invention of the lamp. By September 1882, Edison started distributing electrical power in Manhattan, supplying 110 volts DC to 59 customers. Edison's first steam generating power station was in London, and it supplied power to street lamps and private houses.

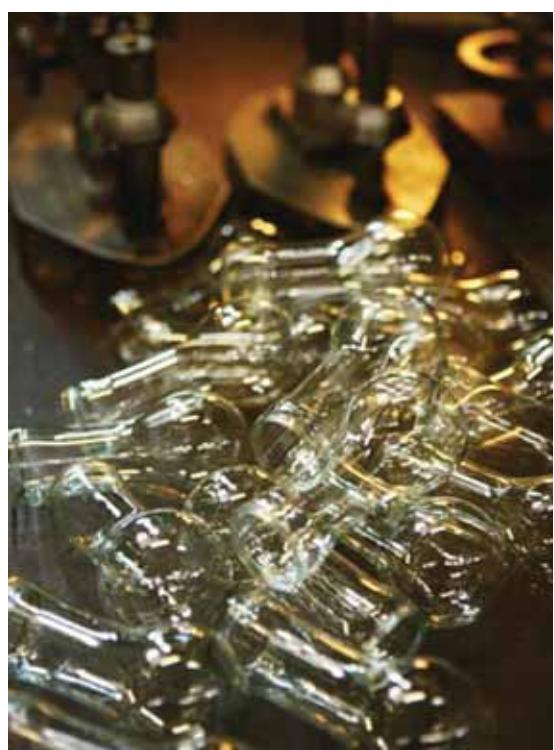
Soon Edison had to compete with George Westinghouse, who promoted an alternating current (AC) system, invented by Nikola Tesla. AC could be stepped up easily to high voltages, sent over thinner wires and stepped down at the destination, unlike DC. DC power plants could supply customers only up to 2.4 kilometres away. Edison's answer was to launch a campaign to convince people that AC was too dangerous to use. A 'war of currents' was on to prevent AC from being adopted. Edison went to the extent of electrocuting animals and developing the electric chair to demonstrate the lethal potential of AC.

DC lost to AC in power generation and distribution. But low voltage DC distribution was used for many years. DC systems had the advantage that large battery banks could supply power continuously. During the DC distribution days, rotary converters, or motor-generator sets, which could convert DC to AC of various frequencies, were seen at various utilities. Rectifiers were used to convert low voltage AC to DC for fans, pumps, lifts and other DC loads. DC was available to customers in New York City till as recently as November 2007.

A PLANT TO MAKE BULBS

A manufacturing unit can make 1200 bulbs each minute, and it runs round the clock and practically every day of the calendar. The process revolves around the production, moulding and subsequent treatment of glass. Glass is melted and drawn continuously from a furnace, received on rollers cooled with chilled water.

The molten glass is formed rapidly around moulds mounted on a conveyor belt. As the belt runs on, outer moulds, mounted on another belt, come into place around the glass-surrounded inner moulds, the bulbs taking shape as these two belts run together



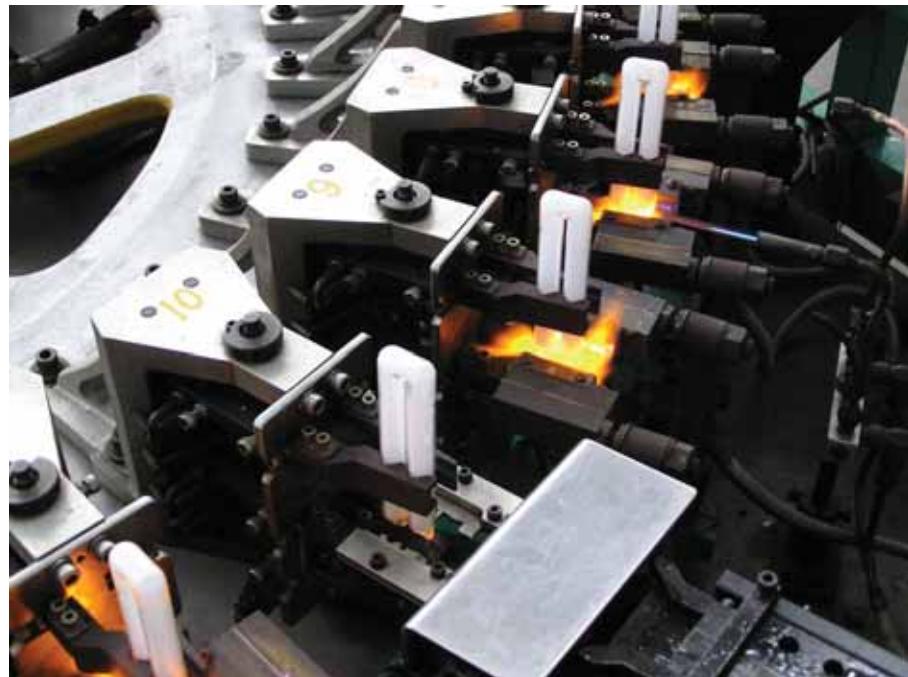
briefly before parting. As the belts separate, the bulbs, now formed and cooled sufficiently, are demoulded.

As they are conveyed, looking like so many shiny and transparent eggs, surprisingly with no breakages, the bulbs are subjected to annealing. They may also be coated with ammonium stearate or other substances en passant. At one point this glacier of glass has a confluence with another moving mass of glass, this one consisting of the 'flares' on which the electrodes and flares are fitted. With limited human supervision, actuators come into play, assembling the bulbs at astonishing speed.

The testing, packing and handling of the finished lamps is also largely automatic. Indeed, the speed of production is so great that no humans could carry out the operations so efficiently.

Fluorescent tubelights are also produced by a similar process. In the first step the molten glass from the furnace is fashioned into a tube as it cools, the tube being drawn out rapidly. This tube is at a very high temperature, and it emerges on a line of rollers that are cooled with compressed air. The tube is cut neatly into four-foot lengths by rotating cutters, and even as these lengths speed past on the rollers, their ends are heated by high temperature flames to strengthen them.

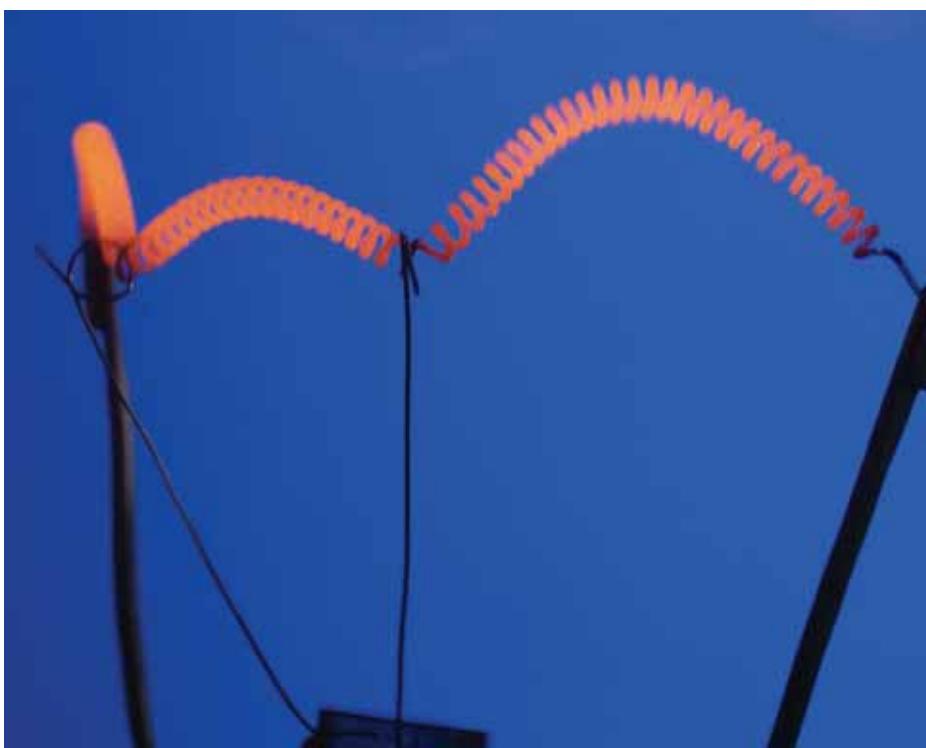
As with the bulbs, flares bearing electrodes and filaments are pressed on to the ends of the tubes, which is why the ends need to be specifically strengthened. The flares are themselves made from narrower-diameter glass tubes that have been cut in the hot condition and pressed while still hot. But



before the flares and filaments can be fitted on the tubes, they must be coated with fluorescent chemicals and heated in an oven till the coating bonds permanently with the shell.

The coated and dried tubes fall on to cloth conveyors en route to the next operation, one expecting them to shatter and roll as they fall. But it has all been calculated precisely, so that tube after tube drops on to the conveyor and not one breaks.

The finished shells now go through a series of steps wherein their ends are heated, the filaments-flares picked up, aligned, inserted and fitted on the tubes. All these



A LAMP-MAKING FACTORY RELIES HEAVILY ON COMPRESSED AIR FOR ITS OPERATION. THE IMPORTANCE OF COMPRESSED AIR IN THE PLANT CANNOT BE OVEREMPHASISED.

**CFLs ARE MADE BY PLANTS
SIMILAR TO INCANDESCENT
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operations are carried out mechanically, through actuators. Once the two filaments are fixed, the tube is flushed with argon. Next, mercury is added. Finally a capping machine fixes the caps with contacts on to the ends and solders the contacts using gas flames. The tubelights are tested in batches of 15 or so simultaneously. All this is automatically done, as is the final packing.

AIR COMPRESSORS IN THE PLANT

A lamp-making factory relies heavily on compressed air for its operation. The importance of compressed air in the plant cannot be overemphasised.

There are many applications of compressed air in the furnace itself. Compressed air is important in every aspect of bulb and tubelight manufacture. It is blown into the furnace to provide oxygen. The furnace oil is atomised using compressed air. There is a periodic reversal of the left and right burners in any glass melting furnace, and this alternation is driven by pneumatic cylinders. The burner tip is cooled in the furnace using compressed air. The batch charger which provides raw material to the blast furnace is also driven by pressurised air.

If the supply of compressed air or natural gas to the furnace is interrupted for even 10 minutes, the entire furnace needs to be

dismantled and rebuilt. Since this is a process that takes many days to carry out, an interruption of the compressed air supply is not permissible.

Compressed air blows the molten glass into bulbs. Practically all handling and manipulation operations of the bulbs and tubes along the conveyor line are performed using pneumatic actuators. To give just two examples, when the flares are being fixed on the ends of the tubes, each tube may need to be turned over vertically. This is performed with astonishing ease and speed as the tubes reach the appropriate place on the conveyor. This turning over is performed by pneumatic actuators. When the end caps of the tubelights are fitted on the tubes, they need to be aligned correctly so that the electrodes and the contacts match perfectly before they are soldered. This alignment operation too is performed perfectly ad nauseam by a pair of crab pincer-like pneumatic actuators.

To say that the bulb factory cannot function without compressed air would be an understatement.

A NEW ERA

For more than a century, the world has used incandescent lamps. A question mark hangs over the future of this device. The world is increasingly energy conscious, and lamps that are far more efficient are freely available in the market—CFLs and LEDs.

CFLs too are made by plants similar to incandescent lamp and tubelight factories. It appears that it might be some time before LEDs become the standard provider of light for the world.

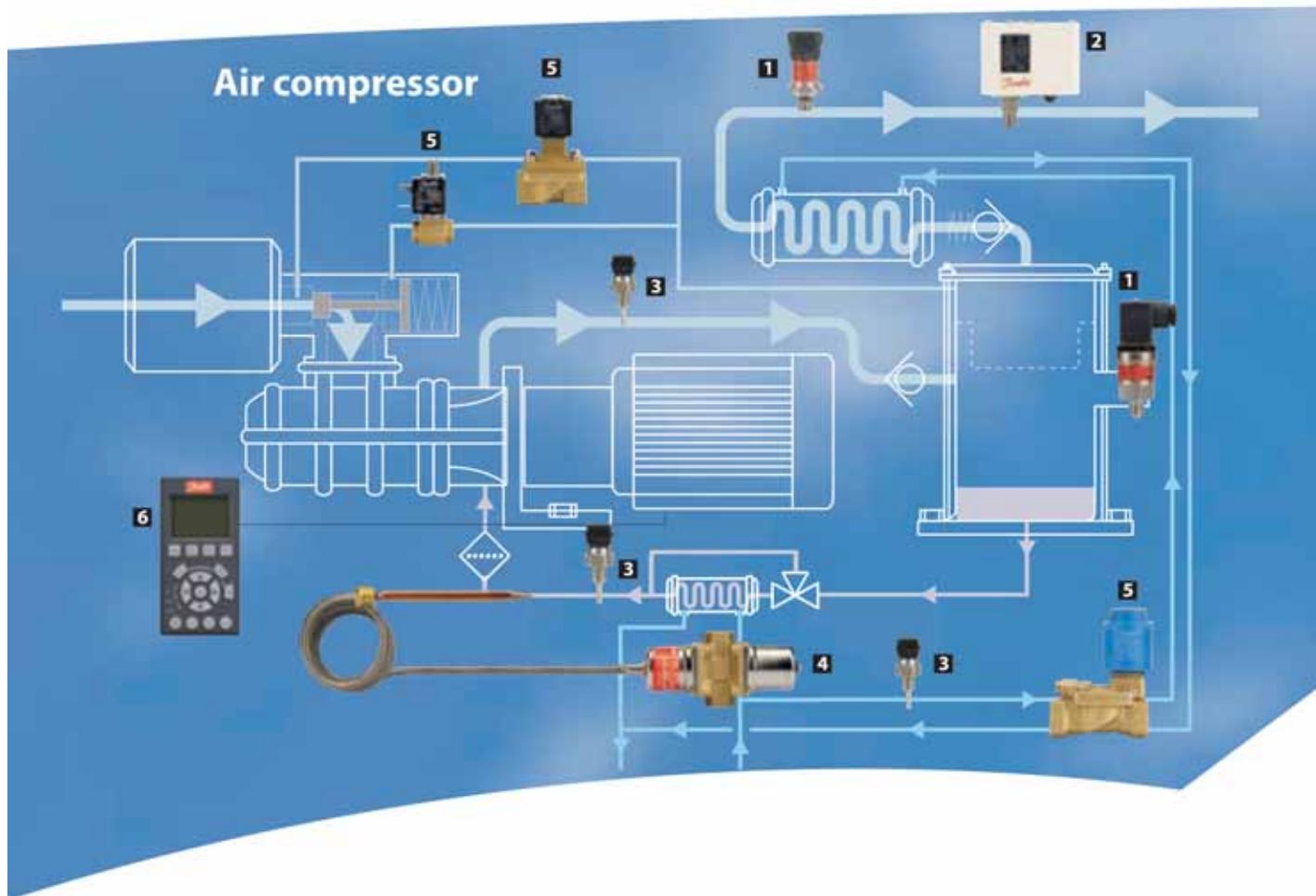
So the lamp-making factories may continue to operate for a long time yet.

Elgi compressors in lamp making facilities

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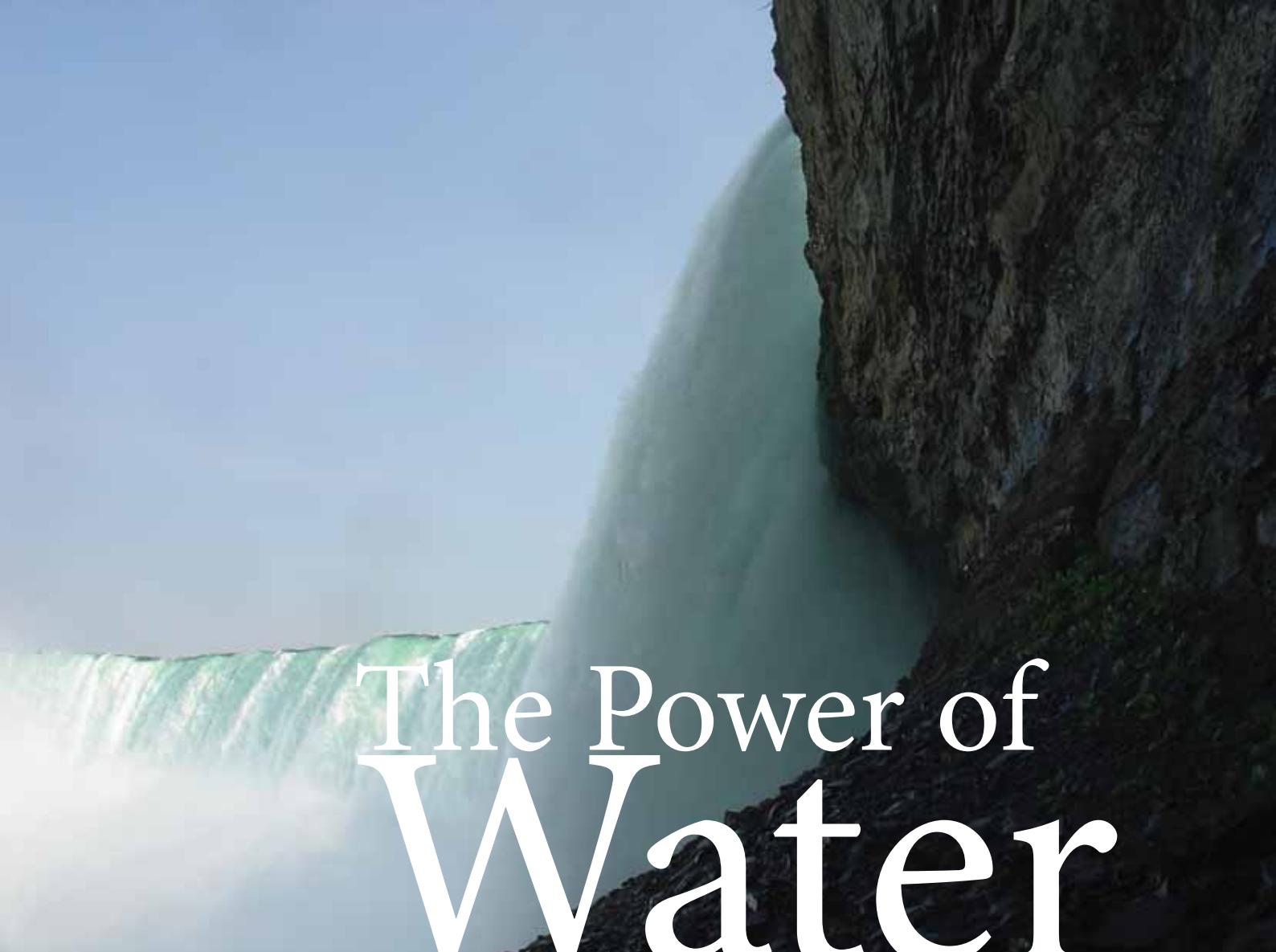
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COMPRESSORS IN HYDEL POWER GENERATION

Energy, technical definitions apart, has been explained as being 'the vital force powering business, manufacturing and the transportation of services and goods to serve... economies'. The term *energy* is used interchangeably with *power*, though the scientist or technologist would frown on this license. Be that as it may, energy is of tremendous topical interest on account of its critical role in the economic output of nations and in their security, as well as on account of the way the living environment is interlinked with it. Energy is used most commonly as electricity, in which form it is highly versatile, and as heat, particularly derived from energy stored in chemicals, which drives engines that can be used for transport.

Much of the world's energy is derived from fossil fuels. More than a third is from crude oil meanwhile coal contributes more than 28 percent. Natural gas follows with a 23 percent contribution. Nuclear

power is the next largest provider of energy, at 7 percent. Hydroelectric power, or power derived from water, is almost as significant, with a 6.56 percent contribution of the world's energy requirements. These sources of energy are on the whole categorized as renewable and non-renewable.

Non-renewable energy sources can be depleted by humans. Energy derived from fossil fuels and even nuclear energy fall within this category. Renewable energy sources, on the other hand, are naturally replenished. It is in fact a common knowledge now that non-renewable sources of energy have continuous, severe environmental impacts compared with renewable sources. With the world power consumption peaking currently at 12.5 terawatts*, the environmental effects of energy production have become increasingly a matter of concern.



SIGNIFICANT AND RENEWABLE

The only major source of renewable energy currently used is hydroelectric power. The world's installed capacity of hydroelectric power was 777 gigawatts* in 2006. This represented a fifth of all the electricity in the world then and 88 percent of the electricity available from renewable sources. Hydroelectricity had its birth in the USA.

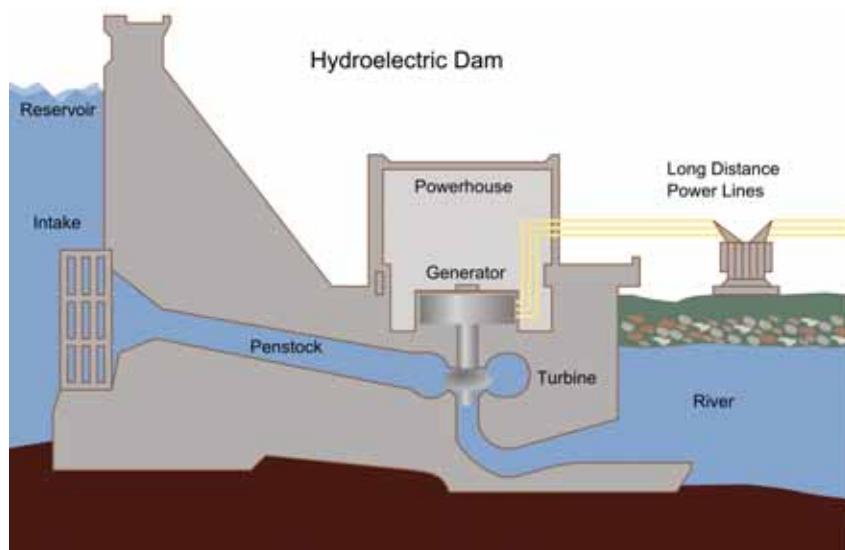
using running water in 1882 at a place called Appleton in Wisconsin.

The development of the water turbine, essential for generating electricity from water, had begun more than a century ago. A French engineer Bernard Forest de Bélidor had initiated this development, writing a book titled *Architecture*

be conducted to the turbine from the dam in a large pipe called a penstock. The difference in height between the water level at the dam and the end of the penstock is known as the head and governs the pressure of the water.

Not all hydroelectric power plants require the construction of a dam. 'Run of the river' plants have no reservoirs. Tidal power plants make use of the change in water level due to tides in the sea.

If the demand for electricity is low at any time, the excess power produced may be used to pump the out-flowing water from a reservoir to another reservoir at a higher



Running water was used to produce electricity for the first time in 1880, soon after Thomas Edison made electric lamps available commercially. A dynamo driven by a water turbine provided the supply of energy to light theatres and shops at Grand Rapids in Michigan. Next year, another turbine-and-dynamo combination provided street lighting at the Niagara Falls. Direct current (DC) electricity was produced in both these instances. Alternating current (AC) was produced

Hydraulique. But the use of water to perform work has a far longer history. It is known that the Greeks used water wheels to grind wheat more than 2000 years back. Most of the electricity generated using water involves a dam. The stored water is released in a controlled manner and used to drive a turbine, which is connected to a generator. The amount of electrical energy generated depends on the amount of water flowing and on the speed and pressure with which it reaches the turbine. The water may



level. Thus when the demand increases, the water may be released back to the lower reservoir, through a turbine. This idea of storing energy is known as pumped storage.

POWER PLANTS GREAT AND SMALL

Hydroelectric power plants have a wide range of generation capacities. The smallest units produce no more than a few kilowatts to 100 kilowatts* of electricity. These units are known as micro hydro plants. Standard

THE SOURCES OF ENERGY



Biomass energy, from plants, is a rich source of carbon and hydrogen, and one that can be used within the natural carbon cycle. Fast-growing plants, such as switchgrass and willow and poplar trees, can be harvested as 'power crops.' Biomass wastes, including forest residues, lumber and paper mill waste, crop wastes, garbage, and landfill and sewage gas, can be used to produce heat, transportation fuels, and electricity, while at the same time reducing environmental burdens.



Solar energy, power from the sun, is free and inexhaustible. Converting sunlight into useful forms is not free, but the fuel is. Sunlight has been used by humans for drying crops and heating water and buildings for millennia. A twentieth-century technology is photovoltaics, which turns sunlight directly into electricity.



Wind power is another ancient energy source that has moved into the modern era. Advanced aerodynamics research has developed wind turbines that can produce electricity at a lower cost than power from polluting coal plants.



Geothermal energy taps into the heat under the earth's crust to boil water. The hot water is then used to drive electric turbines and heat buildings.



Hydroelectric power uses the force of moving water to produce electricity. Hydropower is one of the main suppliers of electricity in the world, but most often in the form of large dams that disrupt habitats and displace people. A better approach is the use of small, 'run of the river' hydro plants.



Coal is the largest source of fuel for electricity production, and also the largest source of environmental harm. Coal provides 54 percent of the US electricity supply.



Oil is used primarily for transportation fuels, but also for power production, heat and as a feedstock for chemicals. The US imports over half of the oil we use, more than ever before.



Natural gas is a relatively clean burning fossil fuel, used mostly for space and water heating in buildings and running industrial processes. Increasingly, natural gas is used in turbines to produce electricity.



Nuclear power harnesses the heat of radioactive materials to produce steam for power generation. Nuclear power provides about 21 percent of US power, but is expected to decline as old plants retire.

Source: http://www.ucsusa.org/clean_energy/clean_energy_101/the-sources-of-energy.html

centrifugal pumps can be used in place of custom-built turbines in micro hydro projects. This reduces the costs involved. Larger units, with a capacity of 1 megawatt*, are known as mini hydro units. Power plants producing up to 30 MW* are in general referred to as small hydro projects.

The smaller power plants may be connected only to isolated communities or even single homes and not to a distribution grid. Such units are common in China.

Interestingly, China also has the largest hydroelectric project in the world, the Three Gorges Dam complex on the Yangtze River. This complex has two generating stations. It is proposed to be completed in 2011 and will produce 22,500 MW* then. The next largest hydroelectricity generating power plant in the world is on the Paraná River in South America. It is the Itaipu power plant

which has 20 generator units, with a combined capacity of 14,000 MW*.

PELTON, FRANCIS AND KAPLAN

Water wheels were among the earliest devices used to tap the power of moving water. Their great drawback was that they were able to convert only little of the water's energy into useful work. Water turbine improvements carried out in the 19th century led to better efficiency.

One high-efficiency turbine that was developed was the Pelton wheel, named after Lester Allan Pelton, who invented it in the 1870s. The Pelton wheel features specially shaped paddles around a rotating rim on which a jet of water strikes. The turbine wheel is known as a runner. The Pelton wheel is most effective when the rim of the runner runs at half the speed of

CHINA ALSO HAS THE LARGEST HYDROELECTRIC PROJECT IN THE WORLD, THE THREE GORGES DAM COMPLEX ON THE YANGTZE RIVER. THIS COMPLEX HAS TWO GENERATING STATIONS. IT IS PROPOSED TO BE COMPLETED IN 2011 AND WILL PRODUCE 22,500 MW THEN.



(left): Pelton Wheel (right): Francis Turbine, Guide Vanes

the water jet. This converts most of the kinetic energy of the water to the output of the rotating shaft. Thus the speed of the water leaving the wheel is very small.

Devices such as the Pelton wheel use the principle of Newton's Second Law and are known as impulse turbines. Another kind of turbine that has been developed is the reaction turbine. In this type of turbine, the pressure of the water drops, in addition to the speed. James Francis, an engineer in Massachusetts, developed a very efficient reaction turbine in 1848. The Francis turbine has an efficiency of more than 90 percent and can be designed to suit a particular flow condition.

The Francis turbine is typically placed at the base of a dam, and the water flows into it with a high speed and pressure. The inlet of the turbine is spiral in shape. Guide vanes, known as the wicket gate, are provided in the turbine. These direct the water inward, and they may be adjusted for efficient operation of the turbine under different flow conditions. The runner itself is provided with vanes as well, the water flow acting on them and causing the runner to spin. The water moves faster as it moves into the runner. It acts on cup-shaped features on the runner as it leaves through the exit, with very little kinetic or potential energy. Francis turbines are the most commonly used kind of water turbine now. They are used to operate in a wide range of heads, from 10 metres to several hundred metres. The power output they span is also wide, from a few kilowatts to a gigawatt.

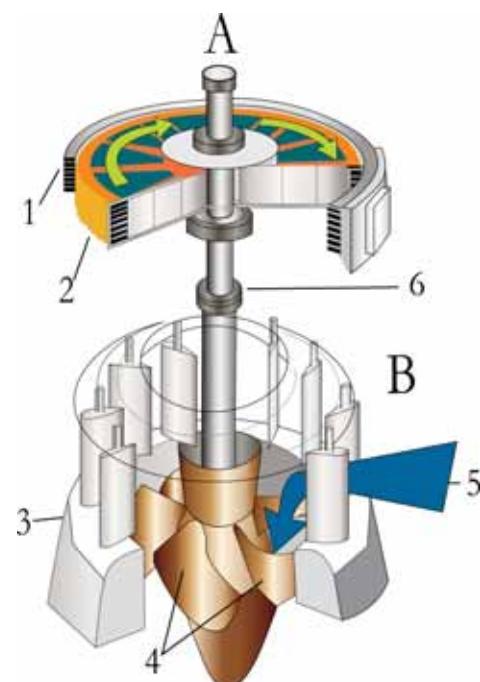
The Kaplan turbine evolved from the Francis turbine. It was developed in the early part of the 20th century by Viktor Kaplan in Europe. The Kaplan turbine has adjustable blades on the runner and it draws power from water even when the head is very low. Kaplan turbines are used widely today, particularly in situations where the head is low and the flow is high. Micro turbines have been made for power generation with as little as two feet of head. The efficiency of the Kaplan turbine over a range of conditions arises from the variable geometry of both its wicket gate and its turbine blades. Kaplan turbines are expensive to design and produce, but they have long operating lives.

When a power plant is running and the electrical load is very low, the speed of the turbine may increase to runaway speeds. A turbine

governor that senses the load on the machine is provided to prevent this. It reduces the flow of water through the turbine. In the case of a Francis or Kaplan turbine, this is achieved by closing the vanes of the wicket gate. Even when the water level in a reservoir drops, the need to regulate the flow through the turbine may require the wicket gate to be closed.

With the head being 600 metres or so in a typical situation, the forces involved in moving the vanes against the flow can be considerable. The entire guide apparatus consists of three parts. The first of these is the top cover, which is essentially a circular ring with around 20 holes, which are fitted with self-lubricating bushes.

Construction of a Kaplan Turbine



A- Generator, B - Turbine, 1- Stator, 2 - Rotor, 3- Wicket Gate, 4 - Turbine Blades, 5 - Water Flow, 6 - Turbine Generator Shaft

The next part of the guide apparatus consists of the guide vanes themselves, and these may have an aerofoil cross-section. The third part is a pivot ring on which the vanes are assembled. The vanes are closed and opened by turning the top cover. Servo motors perform this operation, pressurised oil being used to drive a piston-and-cylinder arrangement. On account of the high forces, the oil pressure may be as high 60 and even kilograms per square centimetre.

The oil is pressurised using screw pumps and sent to a receiver with a dome-shaped top and a cylindrical lower section. The oil occupies a third of the receiver, the rest of its volume being filled with compressed air. The function of the air is to maintain the pressure of the oil, and the air pressure in turn is maintained at the required level using air compressors.

In a Kaplan turbine, compressed air is used additionally to turn the blades of the runner. Again, this is done using pressurised oil and high-pressure air compressors.

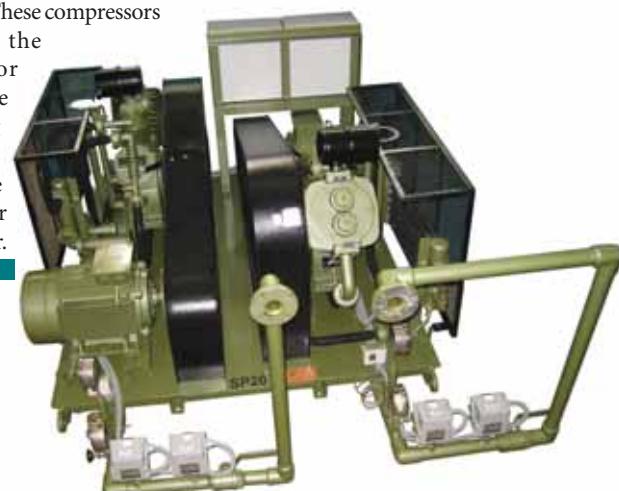
Another application of compressed air in hydroelectricity generation is the opening and closing of valves. Penstocks are often multiply laid. For instance, in a 120 MW* power plant, there may be three penstocks feeding a 40 MW* turbine each. The flow in one or more penstocks must be stopped for maintenance at times. This is done by closing high-pressure valves that may weigh up to 40 tons. Oil pressurised by compressed air is used to operate these valves as well. A high-pressure system provides pressurised oil throughout the powerhouse at the requisite pressure to run the governor.

The dryness of the compressed air is critical because of the possibility of mixing of water with oil. The air must be cooled between compression stages using an inter-cooler and finally cooled using an after-cooler, to less than 45 degrees Centigrade to eliminate the possibility of condensation. The compressors must have auto drain valves fitted on them to vent the condensate.



IN A KAPLAN TURBINE, COMPRESSED AIR IS USED ADDITIONALLY TO TURN THE BLADES OF THE RUNNER. AGAIN, THIS IS DONE USING PRESSURISED OIL AND HIGH-PRESSURE AIR COMPRESSORS.

Elgi's SP 20 400 and SP 20 600 are some of the popular models that are being supplied to BHEL. These compressors provide air for the turbine governor system and the generator braking system, as well as utility air. These compressors deliver 30-35 cfm of free air.



* TW: 1 terawatt = 1 million megawatts MW: 1 megawatt = 1 million watts
GW: 1 gigawatt = 1000 megawatts KW: 1 kilowatt = 1000 watts



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In the depths of **DEAD SEA**



Bordered by Israel, Jordan and the West Bank is the lowest point on land in the world: its altitude 400 metres below mean sea level. The region is very arid, receiving no more than 10 centimetres of rainfall in a year on average - and some parts of it receive no more than 5 centimetres. Its aridity arises from its lying in the rain shadow side of the adjacent Judean Hills. As a result, the skies are clear practically throughout the year with temperatures ranging from 20 to 39 degrees Centigrade.

In this setting, here, in the Jordan Rift Valley is a lake. It has only one major source of water feeding it, namely the Jordan River. There are no streams flowing out of it. Areas of quicksand are to be found around the edge. The lake is more than 60 kilometres long and 18 kilometres broad at the widest. This is no ordinary lake. It is one of the saltiest lakes in the world. Indeed, with a salt concentration of about 31.5 percent, it is several times saltier than any sea. This is the Dead Sea.

Not only is the amount of salt in the Dead Sea high, the nature of the salt in it is also different from that of ocean water. The water in the sea is almost entirely, around 97 percent, sodium chloride. In contrast, Dead Sea water has only 30.4 percent sodium chloride but 50.8 percent magnesium chloride, 14.4 percent calcium chloride and 4.4 percent potassium chloride. It also has the highest concentration of bromide ions to be found in water anywhere on earth. Saturation episodes have caused precipitation of salt on the floor of the Dead Sea.



IT IS CURIOUS THAT THE DEAD SEA IS DEVOID OF LIFE ITSELF BUT IS BELIEVED TO SUPPORT GOOD HEALTH AND RECOVERY FROM ILLNESSES.



papyrus are known to have grown densely in the delta of the Jordan River in the past. Further from the lake, animals such as ibex, hyraxes, foxes and leopards are seen in the surrounding mountains even today. The bird life of the area is rich.

It is curious that the Dead Sea is devoid of life itself but is believed to support good health and recovery from illnesses. Factors that contribute to this beneficial nature of the region include its atmospheric pressure, which is greater than elsewhere, the reduced ultraviolet radiation in the sun's rays, the low level of allergens such as pollen and the minerals present in the water. Each of these factors assists well-being in some way.

The atmospheric pressure is known to assist people suffering from respiratory impairments. The ability to sunbathe for extended periods in the reduced ultraviolet radiation, along with the effects of the air and sea, helps people with skin disorders such as psoriasis.

Even in historical times, the therapeutic nature of this region has been appreciated. The Dead Sea has been a source of a variety of cosmetics, balms and herbal sachets since time immemorial. And there is great interest even today in the use of Dead Sea salts for skin and body care products. Early in the 20th century, the commercial value

As a reaction to the extraordinarily high salt concentration, the density of the water is 1.24 kilograms per litre as against 1.03 kilograms per litre for a typical sample of water from the sea. The most obvious result of this high density is that anyone will float easily in the Dead Sea.

In contrast with most seas, in which life abounds in multitudinous forms, the Dead Sea harbours nothing more than some microscopic organisms such as bacteria. This situation changes only when there is a rare rainy spell of weather. In one notable instance, in 1980, after a rainy winter, the waters of the Dead Sea turned red. This is because of an outburst of an alga called *Dunaliella* in response to a drop in the salinity. The alga in turn supported the growth of red-coloured halobacteria.

Interestingly, areas around the Dead Sea were historically fertile and were used to cultivate valuable crops. Palm trees and

of the mineral wealth began to be appreciated. Potash, or potassium chloride, in particular was exploited for use in fertilizers. The Dead Sea Works was an Israeli company established in 1952 to produce potash and other minerals. Both Israel and Jordan produce millions of tons of potash annually. The operations on the Jordanian side are carried out by the Arab Potash Company.

Arab Potash obtains the raw material for potash extraction from below the sea floor. The sea is typically 20 metres deep, and drilling is carried out 40 metres below the floor. The drilled material is transported to the surface by compressed air. And this is where the air compressors come into play. Elgi's diesel-powered skid-mounted compressors are at work here, bringing up the raw material for potash extraction. This is evaporated in vast salt pans, yielding carnallite, or potassium magnesium chloride. The carnallite is processed further to produce potash.

The origin of the Dead Sea is a matter of debate today, but it is clear that it has had an active past. The level of the lake has changed considerably in the past. The entire area seems to have risen and fallen significantly from its present level. The region is said to have been repeatedly flooded three million years ago. At one



point, perhaps two million years ago, the land rose so much that the flooding stopped, and a lake was created, the predecessor of the Dead Sea. It shrank as the climate became drier, the water becoming saltier. It is believed that seismic events resulted in the Dead Sea dropping to its present level.

The extent of the Dead Sea has been decreasing in recent decades with the diversion of the waters of the Jordan River. The rate of drop of the level of the lake has been a metre a year. Brine in underground layers near the shore has been flushed out by freshwater recently, leading to the dissolving of salt layers and the creation of subsurface cavities and the formation of

sink holes. Meanwhile, Jordan plans to bring seawater from the Red Sea to the Dead Sea. Jordan and possibly Israel will get desalinated freshwater from this effort, and the remaining brine will be discharged in the Dead Sea. Some hydroelectric power will be generated near the lake. There are concerns that the characteristics of the Dead Sea will change drastically because of the tapping of the Jordan River and because of the proposed project.

Meanwhile, Elgi compressors continue to play a significant role in this dynamic and most interesting part of the world.

THE EXTENT OF THE DEAD SEA HAS BEEN DECREASING IN RECENT DECADES WITH THE DIVERSION OF THE WATERS OF THE JORDAN RIVER. THE RATE OF DROP OF THE LEVEL OF THE LAKE HAS BEEN A METRE A YEAR.



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INTERIOR OF AN APOTHECARY'S SHOP.
Late XIV. or Early XV. Century. Flemish.
(From an Old Painting.)

Visits to the hospital have their own unique sets of experiences: the 'checking in' at the reception, the wait with other patients, the preliminary screening by a staff member, the (dreaded) summons to the doctor, the examination and agonising ministrations, the eventual relief on getting a clearance or the gloominess at the prospect of another visit, the despatch to a diagnostic laboratory and so on. Hospitals also have their own smells - floor cleaning liquids, cleaning spirit and the like. To use modern terminology, the entire experience at the hospital is a 'bundled offer'.

During my childhood days, ether was still used as an anaesthetic and its perfectly sickening smell was common in hospital premises. And for the viewing pleasure of waiting patients were displayed in labelled glass jars a variety of excised organs submerged in preservative liquid. Going to the hospital was rather like undertaking a horror ride, come to think of it. You knew this traumatic experience was over when on the way out you presented the doctor's prescription to the compounder who sat behind a window.



The compounder had pestles, mortars and the other tools of his trade around him. He would grind, mix, weigh and dispense remedial powders, with instructions such as 'yellow powder once in the morning and twice in the middle of the night'. That is the way patients obtained their drugs in those days, and a friend of mine who is a doctor says that the compounder's role in a hospital was considered very important. This is reminiscent of the eminence of the apothecary in the past.

APIS AND OTHER INGREDIENTS

If a list of pharmaceutical drugs available today were to be drawn up, its length would be impressive. The list of classes of drugs is itself long. The Wikipedia entry 'Pharmaceutical drug' offers, at the time of going to print, as a sample of the classes of

APOTHECARIES

The predecessor, as it were, of the compounder was the apothecary, a professional who prepared medical formulations for doctors and patients. The first apothecary shops are said to have existed in Baghdad in the Middle Ages. They are reported to have been active in Spain in the 11th century.

We know that there were apothecaries in England by the 14th century because Chaucer mentions them in *Canterbury Tales*. In the 15th century, they enjoyed the status of skilled practitioners. They offered medical advice and performed surgery and midwifery. It was only after the 18th century that their role became more restricted, to that of the modern pharmacist or chemist.



EXCIPIENTS

When laymen talk of a large variety of drugs being available, they refer to what the pharmaceutical industry refers to as APIs, which is short for active pharmaceutical ingredients. The API is only a part of the 'drug' that is obtained from the pharmacist. It is the part that is biologically active. In other words, it is the part that cures you. The dosage from the chemist may even contain more than one API. It also contains an inert part called an excipient, which could be a solid or a liquid in which the API is dissolved.

An API may sometimes be embedded in a matrix or enclosed otherwise so that the drug is released over a period of time. With such sustained-release mechanisms, tablets or capsules needed to be taken less frequently. The level of the drug in the bloodstream is steadier with sustained release, compared with instant-release formulations. Sometimes a drug is coated with an enteric coating to control the drug release rate and to ensure that it is absorbed in the small intestine and not the stomach.

Every ingredient in a drug as well as the products of its chemical decomposition must obviously be identified and guaranteed to be safe. So excipients are added to drugs only when they are absolutely necessary. The minimum amount of excipient required is added.

An excipient may be added because it makes it easier to administer the active substance and it improves absorption by the human body. Often the APIs are required in very small quantities, and excipients provide bulk for convenience and accuracy of dosage. Excipients such as preservatives may also be added to stabilize and extend the life of the active ingredients. Improving the shelf-life of a drug contributes to its competitiveness in the market. Different excipients may be used, and the formulation of an excipient may be considered a trade secret.

Here are some types of excipients and their functions:

Colours: These are added to improve the appearance of a medication or to make it easy to identify.

Flavours: These are used to mask the taste of an active ingredient that is unpleasant. Different flavours ranging from mint and raspberry to cherry and vanilla are used. In chewable tablets and in syrups, sweeteners such as sugar are used.

Fillers: Fillers increase the bulk volume and make it convenient to both produce tablets and capsules and use them.

Anti-adherents: During tablet manufacture they prevent the API from sticking to the tablet punch. Lubricants may also be used to prevent the ingredients from forming clumps and sticking to the punch. Glidants may be used along with lubricants. These improve the flow of a powder by reducing friction and cohesion between particles.

Binders: These give volume and strength. They hold the ingredients in a tablet together. Even solvents may have binders such as starch or sugars added to them.

Coatings: Capsules and tablets may be coated with a variety of materials. These may protect the drug from moisture and may mask unpleasant tastes during swallowing. A capsule or table may be moisture-proofed by using a sorbent. Which limits adsorption or absorption of a liquid or gas.

Disintegrants: These ensure that a table expands and breaks up into small particles when it comes into contact with water, thereby ensuring that the APIs are dissolved and absorbed readily by the body.



medicines, the following: antipyretics (reducing fever), analgesics (painkillers), antimalarial drugs (treating malaria), antibiotics (inhibiting germ growth) and antiseptics (prevention of germ growth near burns, cuts and wounds). Presumably this represents the top of an alphabetic list with a fair number of entries for each letter.

At any rate, the said Wikipedia entry on pharmaceutical drugs goes on to mention some 20 major types of medications, beginning with 'For the gastrointestinal tract' and 'For the cardiovascular system', going through 'For the respiratory system' and 'For endocrine problems' and ending with 'For diagnostics' and, ominously, 'For euthanasia'. A quick and conservative reckoning suggests that on average some

10 categories of medications are listed under each of these 20 major types. As of today, thousands of drugs have been developed and approved.

INDIA IN THE PHARMACEUTICAL WORLD

India occupies a significant position as a pharmaceutical drug producer and exporter. It was ranked 15th in the list of exporters in 2008. The domestic pharmaceutical market of India in 2008-2009 was \$12.2 billion (Rs.55,454 crores), and the country's exports of drugs in the same period was \$8.61 billion (Rs.39,537 crores). The greatest proportion of India's pharmaceutical exports (30 percent) went to Asia. The exports to Europe constituted 24 percent of India's pharmaceutical drug



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exports, and those to North America formed 21 percent of the total pharmaceutical exports. Country-wise, the leading destination was the United States, followed by Russia, Germany, Austria and the United Kingdom.

Pharmaceutical exports contribute around 5 percent of India's total exports. They occupy the fifth place among different categories of goods exported from the country. Ten states together contribute most of India's pharmaceutical exports. Leading among these are Maharashtra, Andhra Pradesh and Haryana.

AIR IN THE PROCESS

Many companies and brands have become well established, well known names in the Indian pharmaceutical market. It is not, however, widely known that there are a number of less recognised companies that supply the raw materials or formulations to the reputed companies.

There are a number of manufacturers in Hyderabad, a centre of drug production, for instance, that each make a ton or more of drugs daily. These units are flexible. They can be used to produce any of a hundred drugs or so each for customers, who may make and pack the final tablets or capsules themselves.

THE DOMESTIC PHARMACEUTICAL MARKET OF INDIA IN 2008-2009 WAS \$12.2 BILLION (RS.55,454 CRORES), AND THE COUNTRY'S EXPORTS OF DRUGS IN THE SAME PERIOD WAS \$8.61 BILLION (RS.39,537 CRORES).



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A wide range of chemicals form the raw materials of these industries, as may be imagined. Most of the production takes place out of sight in large reactors of stainless steel. There is little evidence of the activity within these large, gleaming vessels except the forest of pipes that feed them, some of them bringing in steam,

THE COMPRESSED AIR USED IN PHARMACEUTICAL MANUFACTURE MUST BE FREE OF MICROBIAL CONTAMINATION. THE AIR MUST ALSO BE ESSENTIALLY FREE OF OIL IN MICRONISING OPERATIONS.



others bringing in room temperature water. The chemical reactions proceed round the clock at a manufacturing facility. One of the roles of compressed air in pharmaceutical drug manufacture, which essentially follows a batch processing system, is the transfer of liquid components from one reactor to another in what is essentially batch processing. Typically a compressor may run 16 hours a day. It may be shut down once in 15 days, at which time stand-by compressors take over.

Compressed air is also used in fluid bed coaters (FBCs) and coating pans, in which a core material is suspended in a stream of air as it gets coated with another material. The coated material is typically an excipient. Control of the sizes of the core and the final product is critical. The core material size is chosen using sieves, commonly being a fraction of a millimetre. The final product may be two or three times larger than the core. FBCs require compressed air at a pressure of up to 3 bar.

Another application of compressed air in pharmaceutical manufacture is in drying material. A drier has stacks of trays in which the material to be dried is held. Compressed air at 40 to 50 degrees Centigrade may be passed over each batch for around 10 hours to dry it.

The compressed air used in pharmaceutical manufacture must be free of microbial contamination. The air must also be essentially free of oil in micronising operations. In some applications pure oxygen or nitrogen may be required. Also, the moisture content of the air should be below a specified level, such as 50 ppm. The air may need to be passed through 0.3 micron filters. Elgi offers a range of air compressors which meet these requirements. This range includes lubricated compressors with a combination of driers and filters, as well as oil-free compressors (up to 100 cfm).

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FOOT PRINTS IN A SHOE Factory



Driving to Ambur along a modern multi-lane highway, the ride is extremely comfortable. The roads are broad, smooth and straight. These roads are extremely featureless, and for some reason you can see nothing of the country through which you are proceeding, so that you get bored silly very soon. The tedium is not even relieved by the normal irritation of having to slow down when passing through a town because you do not pass through towns any more. They have built bypasses around them. You pass even large cities without the least inkling that you are doing so.

Uppers before lasting



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Ambur, a town in the middle of northern Tamil Nadu, is one of the major shoe-producing places of India. As one website* that gave details of the footwear industry of the nation put it, "The major production centres [in] India are Chennai, Ranipet, Ambur in Tamil Nadu, Mumbai in Maharashtra, Kanpur in U.P., Jalandhar in Punjab, Agra and Delhi".

The average person who knows anything about the state (I can claim to be one of those) has a vague notion that it is a hot place and fairly far off from anywhere. If this person were to be asked to "list three major sight-seeing spots of Ambur", chances are he or she would be baffled. One could safely say that Ambur does not exactly find a place on the tourist map of Tamil Nadu. So what were we going to Ambur for that February day? We were going to visit a shoe factory there.

We had to stop the car and walk a short distance to reach the factory: the road, a lane really, was too narrow to permit us to drive up to the factory itself. The sunlight was of such strength that to say the heat was intense for this part of the year would have been an understatement.

OVERVIEW OF THE INDIAN FOOTWEAR INDUSTRY



The Footwear Industry is a significant segment of the Leather Industry in India



India ranks second among the footwear producing countries next to China



India produces more of gents' footwear while the world's major production is in ladies footwear



The industry is labour intensive and is concentrated in the small and cottage industry sectors. While leather shoes and uppers are concentrated in large scale units, the sandals and chappals are produced in the household and cottage sector



In the case of chappals and sandals, use of non-leather material is prevalent in the domestic market



Shoes manufactured in India wear brand names like Florsheim, Gabor, Clarks, Salamander and St. Micheal's



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Hand lasting



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Lasts



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YOU COULD SAY OF THE LAST THAT IT COMES FIRST IN SHOEMAKING. THE UPPERS ARE AMOEBOID PIECES OF LEATHER TO BEGIN WITH, AND THESE ARE LAID OVER THE LASTS AND PRESSED ON THEM.

We stood outside the factory. The gate, a modest-sized affair, was closed. Not much of the building was visible from without, and it was impossible to guess the nature or level of operations inside.

Soon the gate was opened for us, and we crossed an open yard to enter the factory building proper. We went in. It was full of operators! The number of people working in that hall was surprising. They were distributed along a series of production lines. I learnt later that there were seven of these lines. All the operators were women - I believe there was not one man among the operators there. There were perhaps 30 operators working at each line. I did not notice it then, but the lines around which the operators were clustered were actually slow-moving conveyor belts, not tables as they appeared to be at first. Various machines stood by the sides of each conveyor belt.

A supervisor took us down one line, explaining the operations involved in the creation of shoes. The factory was equipped to make leather shoes. The upper parts of the shoes, known as uppers, the soles and the heels all came from elsewhere, and they were put together at the factory to make finished shoes. The following is my description of the shoe making process as I understood it.

The shoes are made pair by pair, which seems logical. The size of the shoe (pair of shoes, to be exact) is determined by the lasts used. Lasts, a word which always sounds curious, refers to the forms around which the shoes are created - moulded, as it were. The lasts were rounded bits of hard plastic, half-way between the shape of a foot and that of a shoe. They were greenish blue in colour, and, as may be imagined, they too came in pairs.

You could say of the last that it comes first in shoemaking. The uppers are amoeboid pieces of leather to begin with, and these are laid over the lasts and pressed on them in what is known as a counter-flanging machine. The uppers need to be subjected to a lot of moulding before they begin to look like shoes. After being mechanically formed in the counter-flanging machine, the upper and the last are heated together. Then they are cooled and passed down the line for toe-lasting. As the name of this operation suggests, it gives the toe of the shoe its shape. This too involves pressing the upper on the last.

The shoes-to-be are sometimes sent to the blacking machine instead of the toe-lasting machine. The difference is that during blacking the upper is heated as well. Next, the shoe and last are sent to a bounding machine which looks like a grinding wheel. It is used to remove the wrinkles on the upper. Removal of wrinkles is something that the upper is repeatedly subjected to. The fashion is to have smooth shoes, not wrinkled ones.

Now the soles enter the picture. A pair of soles is selected for the shoes. The shape of the upper is marked on the corresponding sole in the sole-marking operation. The surface of the sole is made rough manually with emery paper. Adhesive is applied on it, and simultaneously the sole is heated in the sole-pressing machine. The upper is ironed to remove wrinkles, and is joined to the sole with application of pressure in the sole-attaching process. The last is now firmly held between the sole and the upper of the shoe.



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I should mention here that the shoes do not move down the line continuously. This is because the machines are not always placed in the sequence of the operations. Thus for some operations the shoes are sent back up the line. This is done by placing them on the lower part of the conveyor belt, which moves backward relative to the upper part!

The combination of the upper, last and sole is now placed in a cooling chamber where the temperature drops to around minus 5 degree Centigrade. This causes the sole to be bonded strongly to the upper - frozen to it, as it were.

Now, towards the end of the shoe making process, the last is removed. This is not as simple as it sounds because it sits tightly in the shoe. You need a machine to scoop it out without damaging the shoe. The un-lasting machine does this deftly.

Before the finishing touches are given, a heel may be nailed on. Multiple nails are driven in by a machine simultaneously. The operation takes only an instant.

Towards the end of the line, the shoe surfaces are polished. The polish is applied in a spray booth after a slight roughing operation. The shoes are brushed by a woollen rotating wheel. Now they gleam and look like brand new shoes, which is not surprising because that is exactly what they are! They get wrapped in paper and are placed in boxes, ready for shipment.

TWO ELGI COMPRESSORS, ONE 75 HP MACHINE AND ONE 30 HP ONE, PROVIDED THE COMPRESSED AIR TO THE MACHINES AT THE SHOE FACTORY. AIR IS SO CRITICAL TO THE ENTERPRISE THAT IF THE COMPRESSORS WERE TO BREAK DOWN, PRODUCTION WOULD SIMPLY STOP.



A number of the machines used in the production of shoes are pneumatic. The counter-flanging machine runs on compressed air. So do the toe-lasting machine, sole-marking machine and sole-pressing machine. The sole-attaching machine is pneumatically operated, as are the un-lasting and heel-nailing machines. The rest of the equipment is electrically, hydraulically or hydro-pneumatically operated.

Two Elgi compressors, one 75 hp machine and one 30 hp one, provided the compressed air to the machines at the shoe factory. Air is so critical to the enterprise that if the compressors were to break down, production would simply stop. The air pressure required was 7 bar at the receiver, with a working pressure of 6 bar. The supervisor told me that each production line required 125 cubic feet per minute.

After the enlightening visit, I performed a rough calculation:

Each 'assembly line' of the factory produces 92 to 144 pairs of shoes each hour. The air requirement of each line is 125 cubic feet per minute. In other words, the line consumed 125 × 60 cubic feet, or 7500 cubic feet, each hour.

Thus to produce a pair of shoes, you needed 7500/144 to 7500/92 cubic feet.

The 'compressed air footprint' of a pair of shoes is therefore 52 to 81.5 cubic feet of air at 7 bar.

Can you consider forgoing your air for a day at work? The role of air in our daily is beyond imagination if you think about it. From the air you breathe to the part it plays in manufacturing mere footwear that we unknowingly are so dependent on, the value of air is unfathomable.

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LARGE NUMBERS

The fascination of humans with natural surroundings is undeniable. Every location on the planet has its own set of living things. And these are found in bewilderingly diverse and absorbing forms: on land there are animals great and small, ranging from elephants and giraffes to mice and tiny insects, plants with flowers and others without, fungi and micro-organisms; in the sea there are fish, whales, octopuses, corals and sea urchins - to name just a few, selected at random.

For long, the floor of the deep sea was considered to be a lifeless domain. Dark, cold and experiencing very high pressures on account of the depth of water, it could not sustain life, or so it was thought. But as techniques to collect the mud from the sea floor developed, it became apparent that this mud was exceedingly rich in small organisms including worms, molluscs and crustaceans.

BACTERIA-IT WOULD SEEM THAT THEY ARE TO BE FOUND EVERYWHERE ON EARTH. AND THEY ARE FOUND IN UNIMAGINABLY LARGE NUMBERS. EVERY PINCH OF SOIL WITH ORGANIC MATTER AND NUTRIENTS, A GRAM OR SO IN WEIGHT HAS TENS OF MILLIONS, IF NOT BILLIONS, OF BACTERIA. EVERY MILLILITRE OF FRESH WATER HAS A MILLION BACTERIA IN IT.

Among these organisms are bacteria that can flourish only in cold water under extreme pressures. Bacteria - it would seem that they are to be found everywhere on earth. And they are found in unimaginably large numbers. Every pinch of soil with organic matter and nutrients, a gram or so in weight has tens of millions, if not billions, of bacteria. Every millilitre of fresh water has a million bacteria in it.

SMALL CREATURES

Bacteria are even found, in large numbers, in our bodies. They are there on the skin and eyes, and they are there in the mouth, nose and intestines. The average human body has 10^{13} (10,000,000,000,000 - a truly prodigious number) cells. At the same time, the size of bacteria is so small that an even greater number of them can live on and within us. Indeed, they outnumber our cells ten times!

Most of the bacteria in the gastrointestinal tract and other parts of the body are quite neutral: they have no known effect on the host. Others are beneficial, performing tasks such as digestion of carbohydrates and production of vitamins. Whereas most bacteria are rendered harmless by the immune system, there are some that notoriously cause diseases, including tuberculosis, leprosy and cholera.

COMPRESSED AIR THERAPY IN MEDICAL EMERGENCY

A particularly dangerous infection that requires urgent treatment is gas gangrene. This is an affliction caused by some bacteria of the genus *Clostridium*, such as *Clostridium perfringens* and *Clostridium novyi*. These are normally found in the soil and in normal gut flora. Gas gangrene develops when these bacteria enter the body through a wound and reach muscles. The bacteria secrete powerful toxins that destroy the tissue. They generate gas at the same time, hence the name gas gangrene.

Once a hiker, trekking across North American woods was attacked by a bear. Though the injuries were not serious, he was badly hurt. The wounded hiker limped off for help. As he was in a remote part of the forest, it was a long time before he found assistance. By then he had developed gas gangrene.

Sepsis, toxæmia and shock follow rapidly once the gas gangrene bacteria reach the muscle. If untreated, gas gangrene is invariably fatal.

The treatment of gas gangrene involves the use of antibiotics and antitoxins and surgery. Antibiotics by themselves are not effective because they do not penetrate the compromised muscles effectively. The damaged tissue must be debrided. Amputation or excision is



Around 4000 species of bacteria have been described. As with the insects, this number represents only a small fraction of the bacteria actually to be found in the world. Again as with the insects, the number of species waiting to be described may be ten to hundred times more than the number described. Recent research indicates that the number may be 1000 times greater, so that the total number of bacterial species may run into the millions.

It is estimated that around 500 species of bacteria are found on the skin alone; but only about 10 species are predominant, making up 50 percent of the total population. In the gut too, there may be 500 species, possibly 1000 species. Collectively, the assemblage of bacteria of an organ is referred to as the 'flora' (thus gut flora) or 'microbiota' of that organ.

Because some species of bacteria are very rare in the human microbiome, being found on only one or a few people in a large group, it has been pointed out that each person may have a unique 'bacterial signature'.

Some studies suggest that the skin populations of bacteria of people with skin disease and people without it are different. Similarly, there may be significant differences between the bacterial communities of people with inflammatory bowel diseases and those of healthy subjects. Other diseases and even obesity may be linked with changes in the microbiome.

SEPSIS, TOXAEMIA AND SHOCK FOLLOW RAPIDLY ONCE THE GAS GANGRENE BACTERIA REACH THE MUSCLE. IF UNTREATED, GAS GANGRENE IS INvariably FATAL, AND IT IS CONSIDERED AS A MEDICAL EMERGENCY.



required in many cases. In addition, the treatment of gas gangrene may call for compressed air or, more precisely, an increased oxygen partial pressure. This therapy is known as hyperbaric oxygen therapy or HBOT, which is not available at all hospitals, and each session may cost from 100 to 1000 US dollars.

Fortunately, the hiker with gas gangrene was transported swiftly to a facility that offered HBOT, and because of timely treatment he survived and recovered fully.

Bacteria such as *Clostridium perfringens* are anaerobic - they can extract the energy

required for running the cell without any need for oxygen. Anaerobic microbes can survive in places such as the gut where the supply of oxygen is low. Disease-causing anaerobes therefore have the ability to affect areas of the body that are not exposed to oxygen. Further, some anaerobes, including *Clostridium* bacteria, are obligate anaerobes - that is, they die in the presence of oxygen. HBOT kills these bacteria through oxygen!

Simply stated, HBOT is the medical use of oxygen at a pressure greater than the atmospheric. HBOT may be used for a variety of conditions ranging from decompression sickness to exceptional blood loss and anaemia.

With decompression sickness or air embolism, the therapeutic effect of HBOT is due to the overall increased pressure. In gas gangrene and a number of other





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conditions, HBOT helps in healing through an increased partial pressure of oxygen. HBOT also increases the oxygen transport capacity of blood plasma and thus of blood itself.

Hyperbaric chambers are essentially pressure vessels. They range from traditional hard-shelled chambers, in which the pressure can be raised to close to 6 atmospheres, to portable home-use models in which the pressure achievable is no more than 1.5 atmospheres. Some chambers are meant for single patients, whereas others can be used simultaneously for eight or more patients. The patients may be provided with pure or concentrated oxygen or just air for breathing. Prolonged breathing of high-pressure oxygen may lead to oxygen toxicity - oxygen is potentially dangerous even for humans!

Treatment with hyperbaric oxygen can be very uncomfortable as a pressure difference develops between the hyperbaric chamber and the middle ear of the patient. The air within the chamber may become misty and warm as the pressure increases. And, of course, in a small chamber the patient may feel claustrophobic.

The pressure changes can cause barotrauma or a 'squeeze' in the lungs and inside sinuses. The lenses of the eyes may swell, leading to temporary blurred vision.

But there is really no alternative to HBOT if a life-threatening infection is involved. And what is a little 'popping' of the ears or even a highly claustrophobic feeling - for a limited time compared to terrible pain of the illness and the possibility of death?

In HBOT, compressed air is life saving, indeed.

Conditions for Which HBOT May Be Used

- Air or gas embolism
- Carbon monoxide poisoning
- Gas gangrene
- Acute traumatic ischaemias
- Decompression sickness
- Enhancement of healing of selected problem wounds
- Exceptional blood loss
- Intracranial abscesses
- Necrotizing soft tissue infections
- Refractory osteomyelitis
- Delayed radiation injury
- Compromised skin grafts and flaps
- Thermal burns

Other Reported Applications

- Autism
- Diabetically derived diseases, such as diabetic foot and diabetic retinopathy
- Epidural abscesses
- Certain kinds of hearing loss
- Radiation-induced haemorrhagic cystitis
- Inflammatory bowel disease

Source: Wikipedia

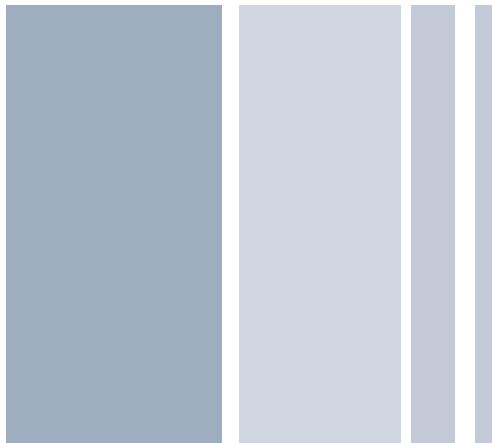
Flexair

BLEED AIREND

ELGI HAS DEVELOPED A NEW SCREW COMPRESSOR SYSTEM, THE FLEXAIR, WHICH CAN INCORPORATE A CAPACITY CONTROL SYSTEM AND GIVES TREMENDOUS ADVANTAGES IN MANUFACTURING LOGISTICS, COST, QUALITY AND INVENTORY CONTROL.

An air compressor is normally designed for operating at one particular speed. Run continuously at this speed, the compressor performs optimally. However, in practice, continuous operation at the optimal speed is rare. This is because the demand for the compressed air produced by the machine, the load, is constant only in few applications. A situation with a varying load is far more common and it represents a challenge in the efficient operation of a compressor. The compressor may waste energy in such situations, or it may be subjected to high levels of wear and tear because of frequent stopping and re-starting. Ideally the system should operate such that the amount of air it produces is in line with the demand, without any waste of energy. There is therefore a need for a form of capacity control in a compressor. Various capacity control methods are used in screw air compressors.

One of these methods is throttling the suction, or controlling the amount of air entering the compressor. Whereas this offers the desired capacity control, throttling the air at the intake valve causes pressure losses. Beyond a point throttling for capacity control becomes inefficient as the power supplied to overcome these losses offsets the power gained by capacity control.



The quest for an energy- efficient airend by Elgi



ELGI IS DEVELOPING THE NEXT VERSION OF FLEXAIR WITH A CAPACITY CONTROL SYSTEM WHICH WILL HAVE EVEN GREATER FLEXIBILITY AND WILL NOT HAVE THE DISADVANTAGES OF OTHER CAPACITY CONTROL SYSTEMS.



Blowing off, or letting out, excess pressurized air is a way of tackling a reduced load. This method clearly offers no advantage in terms of power consumed. It is also unsuitable for use with oil flooded compressors because it releases oil along with the compressed air.

The use of electronic variable frequency drives (VFDs) to vary the speed of the driving motor is growing. This is an excellent system that responds to the load fluctuations very well, but the cost of the VFD is disproportionately high in comparison with the energy gains derived. Moreover, there are losses in the VFD equipment which partially offset the gains. The use of a bleeding port and a sliding valve mechanism is another method. A bleeding port is an opening provided on the airend which lets partly compressed air out. The air is sent back to the intake of the airend, and a sliding mechanism controls the opening area of this port. This method offers unlimited capacity control. But it involves the use of various sliding parts, with associated problems related to maintenance. This makes the sliding valves unsuitable in general.

A common drawback of all these methods is that the compression system operates most efficiently only over relatively small capacity reduction ranges—for example, from 70 percent to 80 percent of the rated capacity. Below these limits, there are no gains in power.

Elgi has developed a new screw compressor system, the Flexair, which can incorporate a capacity control system and gives tremendous advantages in manufacturing logistics, cost, quality and inventory control. Compressors of the Flexair series are available in the power range from 15 kW to 45 kW, but they all have at the heart of the machine the same airend. Thus a single direct drive air end with two l/d ratios is used for the entire range from 15 kW to 45 kW; hitherto two airends and 15 gear ratios were used in compressors in this range. This high flexibility has been achieved using two bleeding ports that have been placed at carefully calculated locations and that have been sized appropriately. The bleed ports perform the same form of capacity control as with the sliding valve mechanism mentioned in the foregoing, but in discrete steps; however, the control effected is not dynamic, and the locations of the ports are different in the two systems, which make the Flexair method more efficient than existing systems.

Flexair, in its first version, uses this concept to permanently reduce the capacity of a given airend for the standardization advantages and the flexibility of manufacturing offered. Apart from the manufacturing advantages, at the lower end of the 15 – 45 kW range a larger Flexair airend compared with the existing airend is used. This results in a higher efficiency, and because a bigger airend runs at a lower speed for a given flow, the noise is lower as well. In a Flexair airend a two-pole motor is used at the higher end of the power range, and a four- or six-pole motor is used at the lower end of the range. The economy of scale achieved by using one airend for a wide range of capabilities is passed on to the customer. The manufacturing costs have been reduced further by driving the airend directly using the motor, without a gear train.

Elgi is developing the next version of Flexair with a capacity control system which will have even greater flexibility and will not have the disadvantages of other capacity control systems. A bypass control valve will be provided on each bleeding port in Flexair II. A controller will be used to operate the valves as necessary. Flexair II will feature a main processing unit which receives pressure signals from the air receiver. It will respond to these signals and open or close the bypass valves. By suitable operation of the valves, capacity control of the compressor will be effected.

In the future, Flexair compressors will have multiple motors to convey multi-speed, multi-power capabilities and benefits.

The Flexair offers a number of advantages over compressors with VFDs. The operating efficiency is significantly better. Because the Flexair does not modulate the supply frequency (as the VFD does), it does not distort the supply in the grid. The Flexair is far more silent in operation than a comparable VFD machine. The cost of the Flexair is 25 percent to 30 percent lower than that of a compressor with a VFD.

The Flexair control system is very compact and can be mounted on the motor body itself. The simpler technology means that the Flexair system is less prone to failure compared with VFD machines.

Elgi has determined critical parameters such as the position and size of the ports through theoretical calculations, prototypes and field testing over three years. Flexair technology has been patented by Elgi.

S A N D B L A S T I N G

Demons, windmills and eggshells

WHEN ONE THINKS OF ANY CONSTRUCTIONS THAT HAVE SURVIVED FOR LONG PERIODS OF TIME, JUST A COUPLE COME TO MIND, TO WIT, THE GREAT WALL OF CHINA AND THE PYRAMIDS OF EGYPT.



UNFLAGGING AGENTS

It seems to be an unwritten rule that if human artefacts and constructions are not tended to constantly they will be covered up or destroyed entirely. Any number of examples of this rule can be cited. The remains of the Harappan Civilization were literally underground when they were discovered. The Mayan city of Calakmul disappeared in the thick forest that grew up around it once its builders moved out. The buildings and other objects involved in these obliterations have been the victims of unflagging agents of nature working to reduce everything created by human effort to dust.

These demons are busy all around us even now. You will find, even in the middle of humanity-infested cities, banyan and fig trees growing on buildings, their roots either making their way tentatively into cracks or already gripping them firmly. Give them time, and these plants will quite engulf entire walls or even buildings.

It would seem that there is a collusion or conspiracy in progress, with non-living factors involved as well. Wind carries in layers of dust all the time, covering every surface and eventually burying every object. Water does the same, bringing soil and stones, dislodging and transporting everything. The sun and storms, helped by the occasional earthquake or tidal wave, eventually bring down even the largest structures man builds.

When one thinks of any constructions that have survived for long periods of time, just a couple come to mind, to wit, the Great Wall of China and the pyramids of Egypt. Both are, significantly, constructed of stone, bricks and the like.

SOME MATERIALS ARE STABLE: OTHERS BREAK DOWN

Of all the materials used by human beings, materials derived from the earth - such as mud, ceramics, glass and even concrete - are the most immune to chemical



STEEL DISPLAYS AN INCONVENIENT TENDENCY TO CONVERT INTO ITS OXIDES, THAT IS TO RUST, IN THE PRESENCE OF OXYGEN AND WATER-IN OTHER WORDS, WHEN EXPOSED TO THE AIR IT REVERTS TO THE SAME COMPOUND THAT MAKES UP ITS ORE.

degradation. Given the fact that the earth's crust is mostly made of stone, sand and suchlike materials it is perhaps obvious that these do not change into other substances at any appreciable speed. When compared, any other material breaks down easily and quickly.

Plastics are presently under criticism for over-usage and environment-unfriendliness. But under the action of the radiation of the sun and air, even plastics eventually break down. It is estimated that any plastic will completely decompose in 500 to 1000 years (but unfortunately no human will live long enough to verify this, of course).

Wood, being an entirely natural material, gets consumed or recycled readily. Various animals chew through it or consume it even as the rain, heat and sun act on it. A number of insects, such as wood-boring beetles, lay eggs within wood, and the grubs grow up within, weakening and destroying it. Termites need no introduction as wood consumers par excellence.

Metals, characterised by great strength, heat and electrical conductivity and other such useful properties are rarely found in nature in the elemental state. Most metals are found as compounds, such as oxides, which are far more stable than the element.

Iron, a metal of sterling properties, if that is the term to use, is very widely used on account of these properties. Steel is an alloy that has even

better properties and finds even wider use. In nature iron is found as ores including haematite and magnetite, which are oxides of the metal. It must be extracted from these ores with the expenditure of much energy. The ore must be heated with carbon to high temperatures.

Steel displays a tendency to convert into its oxides, which is to rust, in the presence of oxygen and water - in other words, when exposed to the air it reverts to the same compound that makes up its ore.

STEEL MUST BE PROTECTED

Steel rusts even in the time that it takes to fabricate parts out of it. The rust, of course, begins to form from the surface inwards. If the rusting process is allowed to proceed long enough, a load bearing structure may get severely weakened, leading to disastrous consequences.

In the case of smaller surfaces, the treatment of rust is simple enough. The rust is scraped away using sandpaper or another abrasive. Then layers of paint that form a protective coat on the steel are applied. Once these are in place, the oxygen and water in the atmosphere, which are the main culprits in the formation of rust, cannot attack the steel any longer.

But in larger structures of steel, the manual use of sandpaper is too laborious and uneven to be practical. Imagine removing rust from the innumerable steel sheets, rods and angles used to make a ship's hull or from a windmill, which stands 250 feet tall. The answer to speedy and even removal of rust and other undesirable material in such cases is sandblasting.

SANDBLASTING

Sandblasting is a general term used for the process of smoothing (or roughening) and cleaning a hard surface by forcing solid particles across that surface at high speeds. It is more technically accurately called 'abrasive blast cleaning' because many different abrasives are used in sandblasting. Indeed, sand is not used! A stream of the abrasive material is driven forcibly against the hard surface involved.



SHOTBLASTING OF WINDMILLS

The metallic components of windmills need to be shotblasted before they are given a final lick of paint prior to installation. Manufacturers of windmills send the nacelle and tower to sandblasting service providers. Trichy is a major sandblasting centre in Tamilnadu at present, with some blasting being carried out at Chennai.

A compressed air pressure of 7 bar is required for the process of sandblasting. The delivery requirement is typically 300 cfm or so. The abrasive ('grit') needs to be of 1.4 mm to 2.6 mm size, and the nozzle size is 8 mm to 10 mm.

When the windmill components arrive at the blasting facility, they are covered with rust and look as though they have a brownish or reddish fungus growing on them. The blasted windmills are usually painted white, so that when they are eventually installed in wind farms they look like an army of gleaming giants swinging their arms around, doing what is known in Australia as the 'bush salute'—driving away bush flies from their faces.



Variants of the abrasive blasting process are known as *bead blasting*, *shot blasting* and *soda blasting*. The abrasive of choice is propelled using a propellant, typically compressed air or pressurized liquid. In the compressed air version, the role of the pressurised air is comparable in importance with that of the abrasive.

In a typical sandblasting facility, the abrasive is held in a hopper. From here it is driven by compressed air into a hose. In some systems a flow of compressed air creates a vacuum which draws the abrasive. More compressed air is mixed with the abrasive in a mixing chamber. The mixture of abrasive and compressed air is directed by means of a nozzle at the work piece. The nozzle is made of a wear resistant material such as a ceramic, silicon carbide, boron carbide or tungsten carbide.

The blasting equipment includes abrasive metering valves, blast hose couplings and hoses, not to forget, of course, the air compressor. Diesel powered air compressors are commonly used.

Sandblasting equipment can be portable or in the form of bench-mounted units. In automated units blasting is carried on under cover to protect the work piece and to protect the environment from dispersing abrasive.

The abrasive is usually recovered for re-use. Some of the abrasive particles get consumed in the process of blasting. Some of them spread out into the air, and those that remain decrease in size or change shape as they are re-used.



ABRASIVES USED

Whereas sieved sand was historically used for sandblasting, it is no longer used because it raises large quantities of silica dust, which causes the lung disease called silicosis.

Abrasives that are commonly used include carborundum grit, steel shots, copper slag, glass beads and metal pellets. Other, somewhat unexpected, materials are ground coconut shells, baking soda and corncobs. All these substances create less dust. Each of them produces a distinct surface finish. The number of times an abrasive can be re-used depends on the material.

Soft abrasives such as groundnut shells, fruit kernels and baking soda are used to clean brickwork and stone work. They can be used to remove graffiti without causing any damage to the material underneath. They can also be used to remove conformal coatings from printed circuit boards for re-working them.



IT IS MORE TECHNICALLY ACCURATELY CALLED '**ABRASIVE BLAST CLEANING**' BECAUSE MANY DIFFERENT ABRASIVES ARE USED IN SANDBLASTING. INDEED, SAND IS NOT USED! A STREAM OF THE ABRASIVE MATERIAL IS DRIVEN FORCIBLY AGAINST THE HARD SURFACE INVOLVED.

A system that provides containment of the abrasive, allows the operator to blast the surface and recycles the abrasive is known as a blast cabinet. The operator may view the work piece through a window and use glove holes in the cabinet for manipulation, turning the blast on and off using foot-operated controls. Larger versions of blast cabinets are known as blast rooms, with the operator working inside the room. Operators need protective gear such as a blast helmet, overalls and ear plugs, in addition to gloves. Proper ventilation and a sufficient breathing air supply are essential in a blasting facility.

BEYOND CLEANING

Sandblasting is not restricted to cleaning metal surfaces. It can be used to remove the nondescript debris which accumulates on stone surfaces exposed to polluted air, such as when a temple wall or sculpture is being cleaned for its kumbabishekam. Sandblasting can be used to remove finishes from wood. It can also be used to create works of art such as frosted glass.

A process known as micro-abrasive blasting or pencil blasting involves the use of millimetre sized abrasive particles and a fine nozzle. The jet of abrasive produced thus is fine enough to write on glass or cut a pattern in an eggshell.

ATS ELGI NITROGEN INFLATOR

Deflating GLOBAL WARMING



Have you ever wondered what happens to the old, worn-out tyres when you replace them on your vehicle? Engineers are coming up with innovative ways to recycle and recover the rubber from scrap tyres. Still a large number ends up being incinerated or in a scrap heap or landfill. These methods of disposing tyres add up to major environmental issues.

Incineration produces greenhouse gases, which contributes to global warming. Tyres in scrap heaps collect rain water and turn into fertile breeding grounds for mosquitoes. Nobody even knows how long tyres will remain in landfills since vulcanized rubber is not bio-degradable.

The magnitude of the problem is obvious when you consider the fact that more than 30 million new tyres are manufactured every year in India, and the US consumes ten times as much! So is there anything that each of us can do to increase the life of our tyres, thereby reducing the number of discarded tyres and ultimately our carbon footprint? It turns out that we may indeed be able to make a big difference by making a simple lifestyle change, with a little help from a new product from ATS Elgi.

The solution to the problem is actually an old one - keep your tyres properly inflated. This does not mean that you manually check your tyre pressures every morning (who has the time for that, even if one is lucky enough to have a car equipped with a Tyre Pressure Monitoring System). The idea is not to inflate your tyres more often but instead to prevent them from losing pressure in the first place. To understand



OXYGEN, WHICH CONSTITUTES APPROXIMATELY ONE-FIFTH OF AIR BY VOLUME, HAS A SMALLER MOLECULAR SIZE THAN THAT OF NITROGEN AND TENDS TO PERMEATE OUT OF TYRE WALLS AT A RATE 3-4 TIMES FASTER. IT IS ALSO A HIGHLY REACTIVE GAS AND CAN DEGRADE THE TYRE WALLS ON ITS WAY OUT.

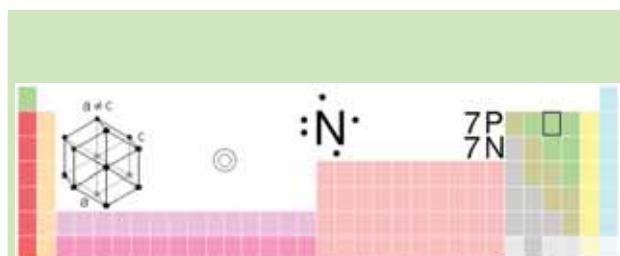
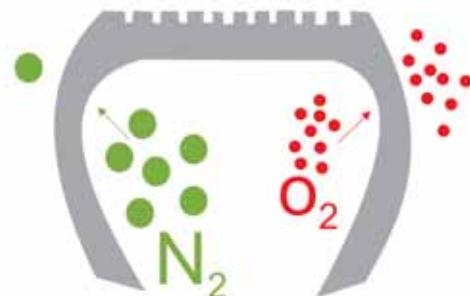


Normally when you inflate a tyre the compressor sends atmospheric air at a high pressure into the tyre, until it is inflated to the desired pressure as recommended by the manufacturer. Air is composed mostly of nitrogen (78 percent), oxygen (21 percent) and argon (less than 1 percent). It also has traces of other gases such as carbon dioxide and water vapour. Since the pressure inside a tyre is higher than the pressure outside, the gases inside the tyre tend to seep out slowly, but they do so at different rates.

Oxygen, which constitutes approximately one-fifth of air by volume, has a smaller molecular size than that of nitrogen and tends to permeate out of tyre walls at a rate 3-4 times faster. It is also a highly reactive gas and can degrade the tyre walls on its way out. The presence of water vapor is also problematic as it causes wide fluctuations in tyre pressure with changes in temperature. In addition, it can cause rusting or corrosion of the wheel, resulting in an uneven contact surface with the tyre and further loss of pressure.

As you have probably guessed by now, using pure nitrogen gas to fill tyres maintains the pressure for a longer time and keeps it stable too. The durability of tyres while using nitrogen depends on how well you maintained the pressure when you used regular air. But the potential savings are high. A tyre that is 20 percent under-inflated will lose approximately 15 percent of its life, while one that is 30 percent under-inflated will suffer a loss of 30 percent! And that's not all - fuel savings of up to 2 percent are also possible with proper inflation. Think of the total savings across many millions of tyres if everyone in the world were to switch to nitrogen!

And now if you are wondering where you can find a station that will fill your tyres with nitrogen, the answer is such stations are becoming more common. But unfortunately fewer than 10 percent of all stations currently offer this service. Only a station equipped with the ATS Elgi Nitrogen Generator for Cars can inflate two-wheelers, cars and mini-trucks (a larger model is available for lorries).



More about Nitrogen

The element nitrogen was discovered by Daniel Rutherford in 1772. It is the seventh element in the periodic table of elements, with an atomic number of 7 and atomic mass of 14. It is a colourless, odourless, tasteless, diatomic gas at room temperature. Molecular nitrogen contains an extremely strong triple bond, which makes it difficult to convert it into any compound - nitrogen is practically an inert gas. However, many compounds of nitrogen do exist, and this gas plays an important role in supporting life on Earth. Nitrogen is present in all animals in the form of proteins, and it is a large component of their wastes. These wastes in turn serve as nutrients for plants



FILLING TYRES WITH NITROGEN GAS INSTEAD OF AIR MAKES IT EASY TO AVOID UNDER-INFLATION, RESULTING IN LONGER TYRE LIFE AND FUEL SAVINGS. SO NEXT TIME YOU FILL YOUR TYRES, ASK FOR NITROGEN!

Features of the Nitrogen Inflator

- First flush technology (FFT) - the air in a tyre is sucked out first and the tube is flushed with nitrogen once before actual inflation.
- Digital display on control panel showing tyre (actual) pressure and set (desired) pressure.
- Air pressure (in the inflator tank) always displayed on an analogue meter.
- Real purity of the nitrogen displayed using an online meter (as opposed to some models in the market that display an irrelevant reading).
- Counter showing the number of tyre inflations carried out provided. This is used for billing the customer.
- Recovery of cost of inflator typically achieved in six months' time.
- Inflation with air instead of nitrogen possible at the touch of a button.

The model 3500 EL Nitrogen Inflator produces nitrogen with a purity of 95.5 percent. It accepts compressed air at 9 bar pressure as the input and separates the nitrogen using Pressure Swing Adsorption (PSA) technology which uses long-life Carbon Molecular Sieves (CMS). Nitrogen gas at 8 bar pressure is produced at the rate of 3500 litres per hour. Condensed water vapour is removed, and the pure compressed gas is stored in 60-litre tanks. When you drive up to have your tyres filled, the process will be identical to filling with air. Just drive away and enjoy the savings.

To sum up, we can all play a part in saving our planet Earth by reducing the number of discarded tyres. One way is to ensure that tyres are always kept inflated at the right pressure. Filling tyres with nitrogen gas instead of air makes it easy to avoid under-inflation, resulting in longer tyre life and fuel savings. So next time you fill your tyres, ask for nitrogen! If your filling station does not offer nitrogen yet, demand that they get the Nitrogen Inflator from ATS Elgi immediately.

What is Pressure Swing Adsorption?

Adsorption refers to the attraction of gas molecules to the surface of a solid material. Each adsorbent has a greater affinity to certain gases. This property can be used to separate the components from a mixture of gases. At a higher pressure, more gas is adsorbed and when the pressure is lowered ("swings") the gas is released. In the ATS Elgi Nitrogen Generator, Carbon Molecular Sieves are used as the adsorbent to separate nitrogen from air. This is economical to obtain relatively high purity, since the whole process is conducted at room temperature.



Nitrogen for Race Cars

Water vapour in air causes significant changes in tyre pressure with changes in temperature. Even small changes in tyre pressure can drastically change the traction and handling of a race car. Over the course of a race, the track and tyre temperatures rise significantly, and for this reason only nitrogen (free of water vapour) is used in race cars. Nitrogen is also used in aircraft tyres since it is not flammable.

Congratulating ELGI on 50 years of success

May our partnership last beyond the horizons



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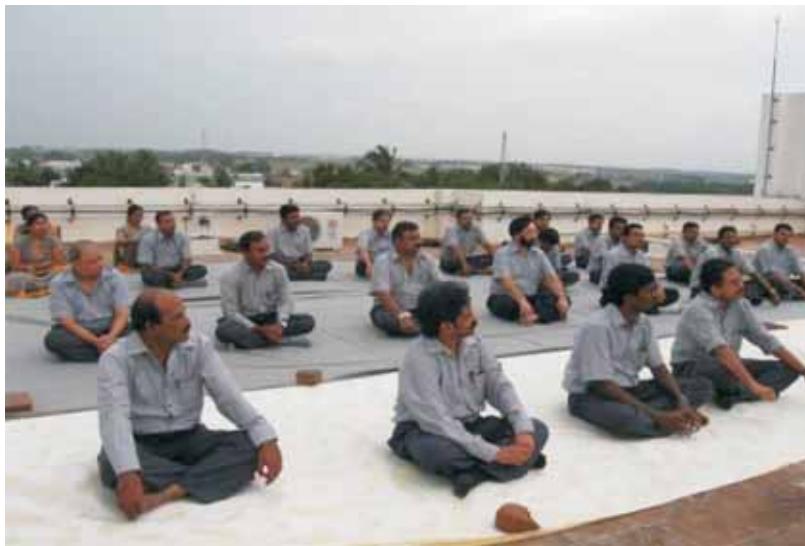
History has blessed India with a rich cultural legacy, yoga being an important part of it. Indians hardly need any introduction to yoga. Derived from the Sanskrit word *yuj*, yoga means to join, to unite, to bind. The word thus signifies the merging of the individual consciousness with the spiritual consciousness - the union of the individual with God.

It connotes integrating all aspects of the individual - body, mind and soul - to achieve a happy, useful and balanced life. In fact, yoga is all about balancing (the) body, mind and emotions through *asanas* (yogic postures), *pranayamas* (breathing techniques), *mudras* (symbolic hand gestures), *bandhas* (interior body locks or bondage), *shatkarmas* (six yogic cleansing processes) and *dyaana* (meditation).

Yoga is believed to have developed in India during the Vedic period, that is, between 3000-2000 BC. Ancient yogis had an in-depth understanding of human beings' true nature and their need to live in harmony with themselves and the environment. Yoga as it is practised today was founded in 600 BC, and the postulates were formulated by Pathanjali.

The oldest formal reference to yoga dates back to 200 B.C. Thousands of asanas were codified in the yogic scriptures. Many of the asanas were inspired by the various elements of nature - mountains, trees, animals, birds etc. We thus have *vrkshasana* (tree), *parvathasana* (mountain), *ushtrasana* (camel), *garudasana* (eagle), *bhujangasana* (cobra) and *bakasana* (crane).

Elgi believes in developing, nurturing and empowering its employees. Elgi aims to shape its staff as total quality individuals (TQI), and the HR - Learning & Development (L&D) department has accordingly introduced projects such as



Project Caterpillar for operators, Total Management for staff and the Personal Effectiveness Programme (PEP) for all. Elgi, being convinced that a holistic development leads man to harmony, peace, health, concentration and balance, naturally turns to yoga for the derived benefits.

PEP was initiated with the objective of empowering individuals at the micro level, enabling them to understand their personalities and realize their growth potential. The programme aims at three main objectives - physical well-being, mental well-being and life force regulation of all its employees. It is based on a set of proven practical techniques that help people become effective and efficient. Experts from Prasanna Trust, Mr. Ramesh Partani and Mrs. Mahalakshmi, who have conducted more than 700 workshops in the corporate field, offered their support

to this project. To reinforce the techniques taught, a follow-up session was held, four months after each programme. Following this, the participants had five PEP value weeks to showcase five PEP values.

The PEP programme was initiated for the middle-management level. After receiving positive feedback from the participants, L&D extended this to employees at all levels, including the operatives. Further to this, a workshop called "LIFE - Living in Freedom - an Enquiry" was held for the senior-management team. It was also supported by the Prasanna Trust. Following the workshop the team practises power breathing exercise for an hour each week.

The statements of some of the workshop participants bear testimony to the assertions regarding yoga's benefits (see box item "Benefits Claimed for Yoga").



Benefits Claimed for Yoga

Yoga, practised on a daily basis, can bring about immense benefits. It can rejuvenate and recharge the physical system and maintain mental equilibrium resulting in an awakening of inner energy. A person who regularly practises yoga will feel fitter, more energetic and happier and is at peace with one's self. There are several paths of yoga, each being a slight variation of the other. They can be classified as *Hatha Yoga*, *Karma Yoga*, *Bhakti Yoga*, *Gyana Yoga* and *Raja Yoga*. They all help us experience good health, mental peace, higher level of awareness, a reduction in ego and an increase in concentration.

Yoga cleanses and purifies the body and mind. It promotes health and longevity. By nature, it is both preventive and curative. Regular practice of yoga controls diabetes, epilepsy and high blood pressure. It is proven that, when practised regularly, yoga reduces osteoporosis, arthritis and back pain, improves blood circulation and decreases the risk of depression and chronic fatigue.

Asanas are not merely physical exercises. They are man's first step towards the spiritual world. Yoga facilitates meditation. A good combination of yoga and meditation helps man delve deeper and deeper into the self.

Yoga works mainly on the endocrine and nervous systems. When we do yoga, the blood supply to the various systems of the body is optimized, and this detoxifies the body. This detoxification delays the ageing process, takes the body to a higher energy level and produces a certain *joie de vivre*. Yoga massages all the internal organs. It improves respiration and increases flexibility. Yoga is a powerful antidote to the stresses and strains of today's hectic lifestyle. Moreover, it removes phobias and negativity of thought. It enhances memory power, concentration and creativity. Some people have escaped from the shackles of addictions by sincerely practising yoga. It is interesting to note that martial arts such as Kung Fu, karate and ju jitsu have evolved from yoga.

Gross National Happiness

The concept of gross national happiness (GNH) is an attempt to define quality of life in more holistic and psychological terms than gross national product.

The term was coined in 1972 by Bhutan's former King Jigme Singye Wangchuck, who has opened up Bhutan to the age of modernization, soon after the demise of his father, King Jigme Dorji Wangchuk. It signaled his commitment to building an economy that would serve Bhutan's unique culture based on Buddhist spiritual values. Like many moral goals, it is somewhat easier to state than to define. Nonetheless, it serves as a unifying vision for Bhutan's five-year planning process and all the derived planning documents that guide the economic and development plans of the country.

While conventional development models stress economic growth as the ultimate objective, the concept of GNH claims to be based on the premise that true development of human society takes place when material and spiritual development occur side by side to complement and reinforce each other. The four pillars of GNH are the promotion of sustainable development, preservation and promotion of cultural values, conservation of the natural environment, and establishment of good governance.



"THROUGH THIS PROGRAMME I LEARNT THE ART OF SETTING COMPREHENSIVE GOALS FOR MY LIFE AND ALSO REALISED THE IMPORTANCE OF TAPPING THE POWER OF THE SUB-CONSCIOUS MIND IN ACHIEVING OUR GOALS"

"This is very powerful and it helps us to focus on our daily activities", says an employee of the Accounts Department. Another staff member says, "I feel better after I started doing this practice and slowly getting relieved of my back pain, which I was suffering from for the last one year".

"Through this programme I learnt the art of setting comprehensive goals for my life and also realised the importance of tapping the power of the sub-conscious mind in achieving our goals", says another employee.

The company believes that when employees enter Elgi, they should feel happy and enjoy their work. There should be a measure to gauge their gross happiness, as in Bhutan. (see box item, "Gross National Happiness").

Elgi takes up the responsibility of ensuring the employees are in good health and in a positive state of mind. The PEP initiative thus helps employees to stay fit and bond better with their family, friends, society, their teams and the organisation as a whole. A follow-up process called "Personal Growth Lab" for the senior management team is in the offing.





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NEW PRODUCTS FROM ELGI , ATS ELGI AND ELGI SAUER

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Going Global

Elgi has introduced a new series of screw compressors in the 11- 22 kW power range. These Global Series compressors represent a giant leap in design and performance, with each component designed for reliability and ease of maintenance. Featuring a compact footprint and producing a noise level of no more than 68 ± 3 dBA, these are the most silent machines in the market.

These new direct drive compressors have a low operating speed, which makes for an extended life and less maintenance. They are fitted with Elgi's energy-saving Flexair Axis airends, which have a unique screw profile and low specific power consumption.

Control of the machines is through Elgi's Neuron controller, which facilitates remote monitoring and data analysis. The Neuron II is integrated with a variable frequency drive (VFD) and a drier controller. Remote diagnostic software sends e-mail reports of faults or failures to the Elgi Customer Care Centre from the customer's site. Elgi's service engineers can thus diagnose the problem, evaluate the performance of the unit and detect malfunctioning components without travelling to the compressor location.

The new family of compressors is designed to run at high temperatures, being fitted with highly efficient after-coolers. A moisture separator with an auto-drain facility is provided to drain condensed moisture. The compressors have been fitted with a unique three-stage vertical separator tank. An easy-to-maintain spin-on filter may be used. No special tools are required for filter maintenance. The design is user-friendly, with easy access for service through a single door.

The Global Series compressors meet the world's most stringent safety norms and have been CE marked. These new generation compressors significantly reduce operating costs, with a payback period of less than 12 months.



Best wishes for
Elgi's 50
years of success...

on the Wheels of Engineering



Eco-friendly and portable

After launching 60 hp electric powered portables, Elgi has again proved its capability to design and customize electric powered portables based on the customer's need. Continuing its eco-friendly initiative, Elgi has developed a new series of electric powered portable screw air compressors, the E75.



This new family of electric powered trolley mounted compressors is dedicated to lowering operating expenses, thus offering higher returns on investment for the customer. Powered by Elgi's unique N-profile energy-efficient airend, the compressors are suited for not only standard applications such as powering breakers and tools in road repair but also for more specialized uses including sandblasting, pigging, drilling and optical fibre blowing. The electric powered portables are ideal for use where electric power is available and in work environments where quiet and emission-free conditions are required.

One of the remarkable features of Elgi's portables is their ruggedness and easy manoeuvrability. Delivering pressures up to 150 psi g, the new units are capable of operating in all ambient temperatures and dusty environments. A high-performance foam pre-filter prevents dust from entering the compressor. The compressor is provided with a height-adjustable towbar and parking brake. As an additional feature, the compressor is designed with a closed base-frame bottom to hold oil spills.

There are three models in the E75 series presently. They have working pressures of 7, 9.5 and 10.5 bar g. Elgi will be shortly launching a range of electric-powered portables catering to the needs of the construction and mining sectors.

Oil-free gains

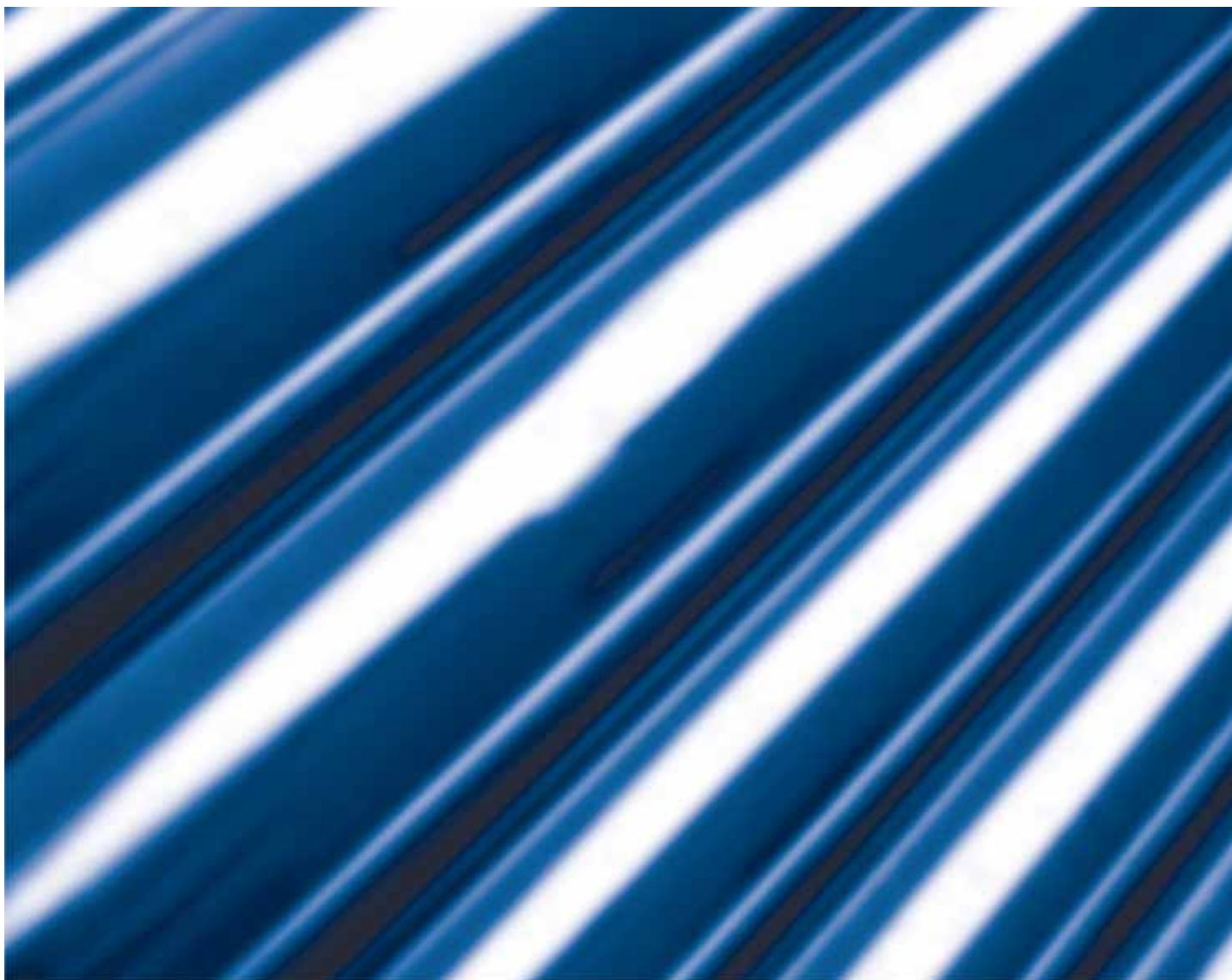
In response to the need among industries and research institutions for compressed air of increasingly greater purity, Elgi has developed reciprocating compressors delivering 35–45 cfm. Two variants each of these 10 and 15 hp machines are available-mounted on an air receiver and on a base frame. Elgi's oil-free series caters to a wide range of applications in industries such as the food, electronics and health care industries, where oil-free compressed air is a necessity.

Elgi's oil-free compressors are engineered on the principle that "no oil in the compressor system means no oil in the output air from the compressor". The compressor uses a dry crankcase that is totally devoid of oil. The compressor operates with no oil in the cylinders.

The internal moving parts of the compressor are designed suitably to function in the absence of lubricating oil. Sealed bearings are used for the crankshaft and connecting rods. The pistons are coated with polytetrafluoroethylene (PTFE), and the cylinder walls are specially coated for wear resistance.

The compressors are designed for 100 percent continuous duty. The elimination of the risks of oil contamination and the resulting extra costs means less expenditure for the customer on maintenance. Expensive oil removal filters are eliminated, as are frequent stoppages for topping up or filling oil in the crankcase.





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Expanding your PET business

The HP 20 400S compressor from Elgi is an extension of its current reciprocating product range up to 33 bar to meet the air requirements of applications such as semi-automatic PET pre-form blowing machines, carbonated soft drinks and etching of shapes in bottles. This product can be run in on/off duty cycles or continuously by selecting the appropriate options on the starter panel. The compressor is provided with piston rings which ensure that the oil carry-over is low.

This compressor has been designed for operator and plant safety to meet OSHA (Occupational Safety and Health Administration) standards. It features a twin sided belt guard and sealed safety valves as the compressor is designed for 40 bar operation.

Elgi offers a host of down stream accessories such as pre-filters, fine filters, oil moisture separators, refrigerant driers and vertical air receivers, all designed to ASME standards.



Redefining oil-free operations



The NH-42 oil-free compressor is the latest addition to the NH series of oil-free screw compressors. These machines deliver 1800 – 2600 cfm at pressures up to 9 bar g. Reliability and low operating costs are the primary benefits that the NH series compressors offer customers. Elgi's oil-free screw compressors ensure an energy-efficient compressed air supply, thanks to the unique NH profile rotors.

Air leakage has been greatly reduced in the NH-42 by maintaining an optimum gap between the screw rotors during the discharge and suction cycles. As a result, the compressor offers a 5 percent greater volumetric efficiency compared with a conventional compressor, thus significantly reducing the operating costs. The rotors are coated with a special resin, which ensures efficient operation of the compressor over a longer period of time.

Ease of maintenance has also been a key advantage with the NH series. The use of long-life bearings results in a dramatic reduction in maintenance costs. The maintenance cycle is thus extended to 50,000 hours, or 6 years, as against 35,000 hours, or 4 years, for other bearings.

Representing more than 45 years of experience in air compression, Elgi's NH-42 redefines oil-free operations.

Enduring Partnerships



Our good wishes on the occasion
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Turbo boost

Elgi offers the new generation SM series Samsung Techwin Turbo compressors with an innovative package design. These multi-stage centrifugal air compressors range in power from 100 to 4400 hp, with flow rates ranging from 500 to 27,000 cfm.

The unitized frame construction is based on modularized design of assemblies and eliminates the need for an expensive foundation and saves on installation costs. The SM series compressors have the most advanced impeller design. They provide unparalleled flow performance with the lowest power requirements and lowest maintenance costs. The optimized control system ensures enhanced efficiency and productivity in diverse industrial applications.



Compressor tracking and remote monitoring system



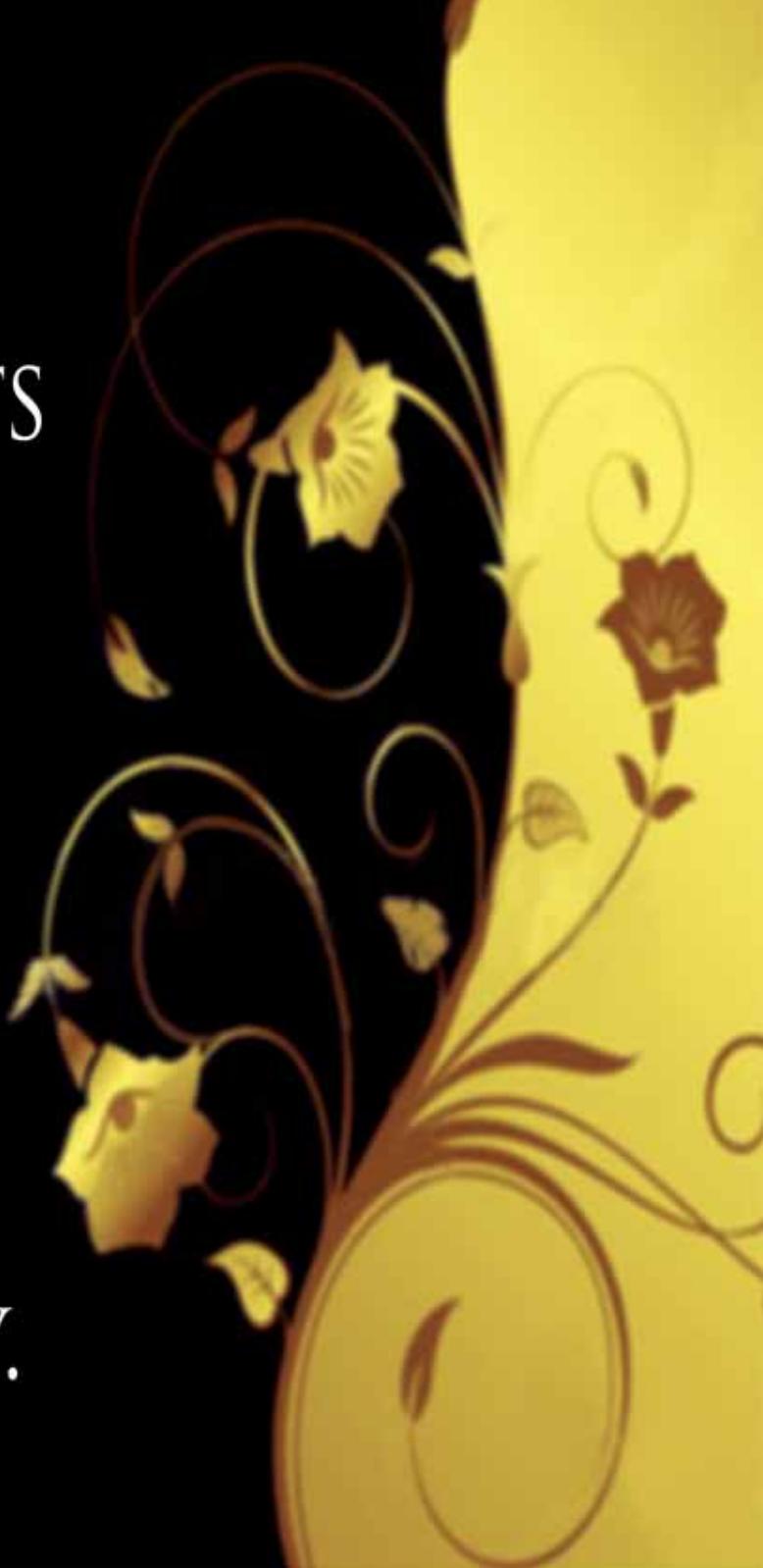
Elgi has introduced a remote monitoring system for portable air compressors in the field. The compressor tracking and remote monitoring system (CTMS) allows customers to monitor their machines in real time. It also allows them to perform preventive and corrective maintenance. Thus customers' costs of ownership are reduced, and they are provided with a wealth of information on the compressor's operation and service.

CTMS provides information on service schedules, the operational history, the utilization and the location of a machine. This enables on-site visits by service technicians to be more accurately timed and more efficient. The system also contributes to energy savings by monitoring the operation parameters such as the load factor and current and the mean load data.

To provide real-time communication from a wide coverage, CTMS uses the GPRS/GSM network, which supplies accurate and up-to-date information at any instant and location. The use of GPRS ensures that equipment can be tracked at all times and at any location. The system is also designed to withstand harsh site environments including dust, water and high temperatures.

If the compressor parameters cross the maximum allowable limits, CTMS sends an alert message to a base station. From the base station the message is relayed in the form of a text message to five mobile numbers. These numbers are configured initially. An e-mail is also sent, to a specified e-mail address.

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Airlube XD

Elgi has launched Airlube XD, a high-performance screw compressor oil, in association with Bharat Petroleum. Airlube XD is exclusively designed and blended from hydro processed, HVI based and fortified with carefully selected and balanced additives to meet the most stringent requirements of modern screw compressors manufactured by Elgi.

Airlube XD is an eco-friendly product with reduced disposal per life cycle. It is available in 20, 50 and 210 litre packs in containers of recyclable material. This oil is specially formulated for Elgi with Group II plus Mak base oil by MAK lubricants, Bharat Petroleum. It can be used in all types of rotary screw compressors. The drain interval period of 4000 hours is much longer than that of conventional lubricating oils. The product has been evaluated extensively by Elgi and performs well in demanding conditions over extended periods.



Thermal mass flow meters

VP FlowMate and VP FlowScope are thermal mass flow meters from Elgi.

VP FlowMate is the professional choice for metering compressed air and flow measurement in pipes up to 2 inches in diameter. It combines state-of-the-art silicon sensor technology with ease of use. VP FlowMate is suitable for compressed air metering, energy monitoring, testing of pneumatic systems, quality inspection and testing, and purge metering. It has a high turn-down ratio and a low pressure drop.

VP FlowScope is an all-in-one meter for measuring mass flow, temperature and pressure simultaneously. It features a built-in display and a built-in data logger. It can be configured via its keypad without the need for a laptop. VP FlowScope is used for compressed air flow metering in tubes of diameter 2 inches and more. It is the ideal tool for mobile audits, field performance measurement, air cost allocation, leak detection, utility management and maintenance planning.





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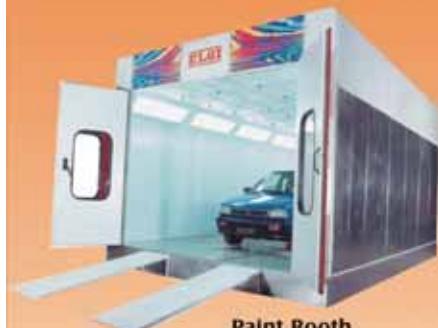


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Tornado: Proven technology

Two Elgi Sauer compressors are available in the newly designed Tornado series: the air-cooled, high-pressure three-stage WP 3215 and four-stage WP 4325.

The Tornado compressors are based upon the established water-cooled WP 5000 Navy compressor, as used in modern submarines, with a vertical arrangement for the running gear and the cylinders in a star arrangement. This configuration is distinguished by a very small foot-print and an almost perfect mass balance, which makes for extremely low values of air-borne noise and vibration.

The outlet temperature is low, only 5 degrees Centigrade above ambient, and the residual oil content is at most 3 mg/m³. These features reduce considerably the expenditure on downstream equipment.

Both the WP 3215 and the WP 4325 are available in basic and 'Comslient' versions. The basic version consists of the compressor and motor, with a separate control panel. The features of the Comslient version include fully automatic electronic control, noise insulation down to 72 dB(A) at a distance of 1 m, an integrated filter, a demistor and a condensate collector tank. The air delivery is 225 to 400 l/min at pressures up to 420 bar.

Tornado series compressors can also be supplied for special applications, including a gas-tight version for compressing helium and another for use in explosion-protected zones in compliance with ATEX regulations.



WP 6000 : Booster Compressor

Each industrial application makes its own specific demands, and the new WP 6000 is an innovative flexible design that can be optimized to a customer's specifications. Using a combination of cylinders, or compression stages, the WP 6000 can be adapted to meet the requirements of flow and pressure. Up to six cylinders can be accommodated, and the compressor, which can also serve as a gas booster, can extend the existing Elgi Sauer range to deliver air, or gases, at any pressure from 10 to 400 bar with flow rates anywhere from 250 to 2000 m³/hr.

Additionally, with a sealed leak-tight pressurized crankcase, the WP 6000 can be used to safely compress hazardous or expensive gases.

The WP 6000 may be cooled using freshwater or sea water. It may be driven using either an electric motor or a diesel engine with a power of 90 kW to 230 kW.



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Wheel Aligner

Perfect alignment of the wheels of a vehicle is important for safety and for steering and driving comfort. It also improves tyre life and mileage. Each car manufacturer specifies the precise wheel settings of its products that are necessary for optimal vehicle performance and for the best ride handling and steering characteristics.

The alignment of the wheels must be checked in the following situations:

1. When unusual tyre wear is detected
2. When steering or handling issues are noticed
3. When the steering direction changes on hitting bumps
4. When replacing worn suspension parts or new tyres
5. During the routine annual service

The wheel aligners from ATS Elgi sport elegant looks. They are compact and require very little maintenance. They are easy to calibrate.

The wheel aligners are user friendly and menu driven. The Help Option is one of the useful features of the interface. Optional alignment features include FAST CASTER, CRADLE, and ELEVATED adjustment. The aligners provide accurate live readings on a colorful digital/analog display. The zoom facility and interchangeable parts of the wheel aligners from ATS Elgi have been appreciated by users. These aligners are designed for most cars available today. They can be upgraded for alignment of truck wheels.



Wheel Balancer

Vibration of the tyres due to imbalance is a common issue faced with all four-wheeled vehicles. This increases with speed, and the vibration is transferred from the wheel assembly to other parts. Most problems due to wheel imbalance do not become apparent until the vehicle speed is about 70 kilometres per hour.

Vibrations in tyres and wheel assemblies may arise from various causes: static imbalance, dynamic imbalance, mounting errors and excessive run-out (radial or lateral). Imbalance of tyres results in reduced riding comfort, low traction due to loss of tyre-to-road contact. Tyre wear is excessive or premature and irregular. This is accompanied by an increased stress on all steering and suspension parts.

Wheels must be balanced not only when the tyres are first installed but also whenever a vibration or wheel tramp problem is noticed. Re-balancing must be performed periodically to compensate for wear. It is difficult to get a perfect balance with retreaded tyres. Balancing has no effect on the alignment of tyres.

ATS Elgi's Wheel Balancer features the revolutionary VDD technology. It may be used to balance wheels of rim diameter up to 30 inches.



Both static and dynamic balancing can be performed using the Wheel Balancer, although the latter is the preferred type. The Wheel Balancer indicates a corrective weight of more than 100 grams for car tyres a wheel faces a run-out problem or if the cone seating is damaged.

Riding becomes a safe and comfortable experience after balancing using ATS Elgi's Wheel Balancer.



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Paradigm shift from service to manufacturing industry

- LG Balakrishnan & Brothers Pvt Ltd., the first company founded for manufacturing automotive service equipment
- Elgi evolves

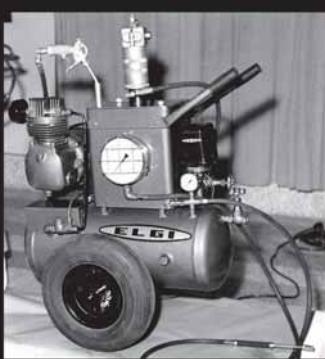


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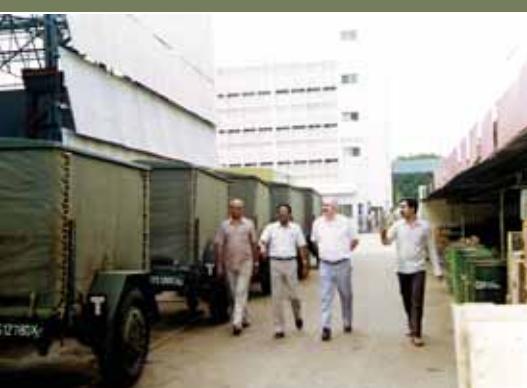
Gobel Collaboration : Pasteurisation plant for Breweries



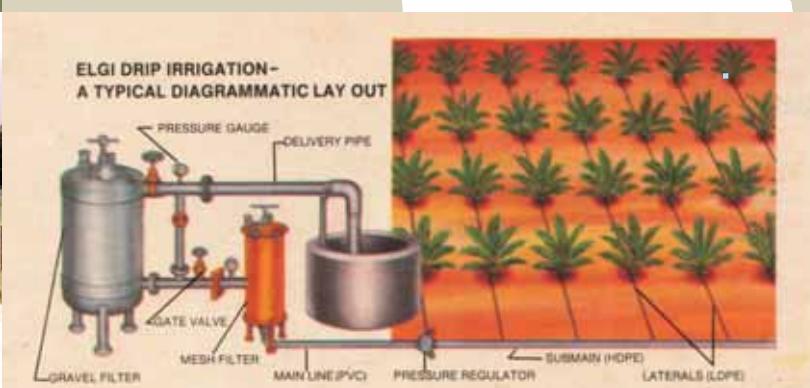
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Collaboration with Sullair for Portable & Stationery Rotary Screw Compressor



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The then Governor M.P. Ramachandran's visit to Elgi during Silver Jubilee celebrations



Portable Compressors manufactured for Jaracom, South Africa



Reciprocating Compressor assembly line

80s spreading wings



ISI marking for Elgi products



Large batch of Compressors getting ready for export to Russia



Two-Stage Screw Compressors developed in collaboration with Sullair



Automatic Vehicle Washer :
Technology adopted from CECCATO, Italy



KRONES Collaboration : Bottle washing unit



New High Pressure Compressor and Railway Compressor production line introduced



Export of Portable Screw Compressors to Bangladesh



Bowsers supplied to Indian Oil Corporation



MKB High Pressure Compressors developed for defence warships



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High Pressure Compressors developed for naval applications



First cab manufactured for Caterpillar/HM

Revolutionizing Farming: Compressors for raising water from borewells





Collaboration with
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Partnership with Karcher, Germany for marketing
and servicing Cleaning Equipments



First Batch of 11KL Aircraft Refuellers for
Indian Air Force



Partnership with Werther, Italy for marketing
and servicing Wheel Balancers, Oil Suction
Units and AC Recovery Plants

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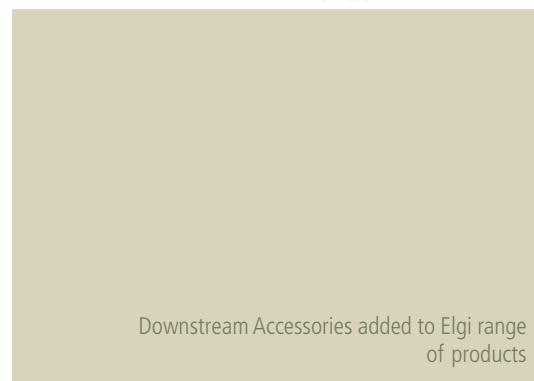
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Horizon series of rotary screw air compressors developed in-house in collaboration with City University, London



Elgi Pneumatic Tools launched in technical agreement with SP Air of Japan



Tractor Compressors used for Jack hammer and sand blasting applications



Oil-free Screw Compressors introduced after technology partnership with Hitachi, Japan



Elgi gained the technology to make Airends



Strategic tie-up with Samsung Techwin, Korea for packaging and marketing Centrifugal Air Compressors in India



Manufacturing and Engineering operations starts to focus on precision engineering products

Elgi designs and develops the world's smallest Screw Air Compressor

Launches Tank Mounted Rotary Screw Compressor



Elgi goes lean



Elgi spins-off Automotive Equipment Division into a 100% subsidiary - ATS Elgi Ltd.

New Horizons



> Set up production centre in China
> Warehouse facility in Middle East



Global Series Screw Compressors



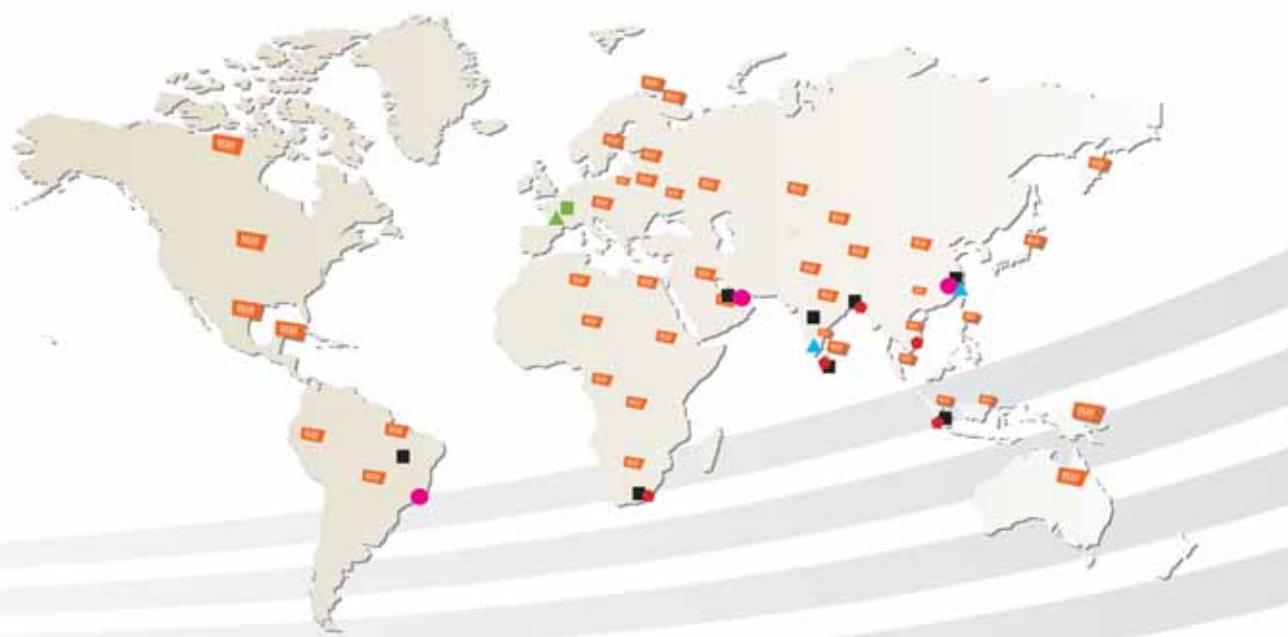
Developed Oil-free Airend: A significant achievement of Elgi

Indigenously developed Oil-free Reciprocating Compressor



Going Global

> Warehouse facility in Brazil
> Entry into Europe through Belair acquisition



Customers Personnel Wholly Owned Subsidiaries Production Centres and Offices Overseas Offices



Make a wise move



Super Energy Efficient Motors

Ministry of power has mandated the minimum energy efficiency rating on limited products. The day is not far when everybody looks up to Super Energy Efficient Motors to meet their energy savings requirements.

- Energy Saving, Low life cycle cost
- EFF1 class as standard \geq 250frame
- Robust design for higher reliability and uptime
- Full range EFF1 and EFF2 class motors
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Answers for industry.

SIEMENS

Branch Offices

| | |
|--------------|--|
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| BANGALORE | 15,16 Richmond Road, Bangalore - 560 025 Ph: 91-080-22220296, 22240674 Fax: 91-080-22293274 E-mail: elgibangalore@elgi.com |
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| TIRUCHENGODE | 4/2, Nandhini Complex, 1st Floor, Vellore Road, Tiruchengode - 637 211 Ph: 91-4288-257137 Fax: 91-4288-257693 Email: elgitiruchengode@elgi.com |

Overseas Offices

| | |
|------------|--|
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| SRI LANKA | S.G. Arcade, 2nd Floor, No.441, Sri Sangaraja Mawatha, Colombo-10 Ph: 00-94-11-2392425, Fax: 00-94-11-4737412 Email: elgisupport@slnet.lk |

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Factory & Registered Office

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