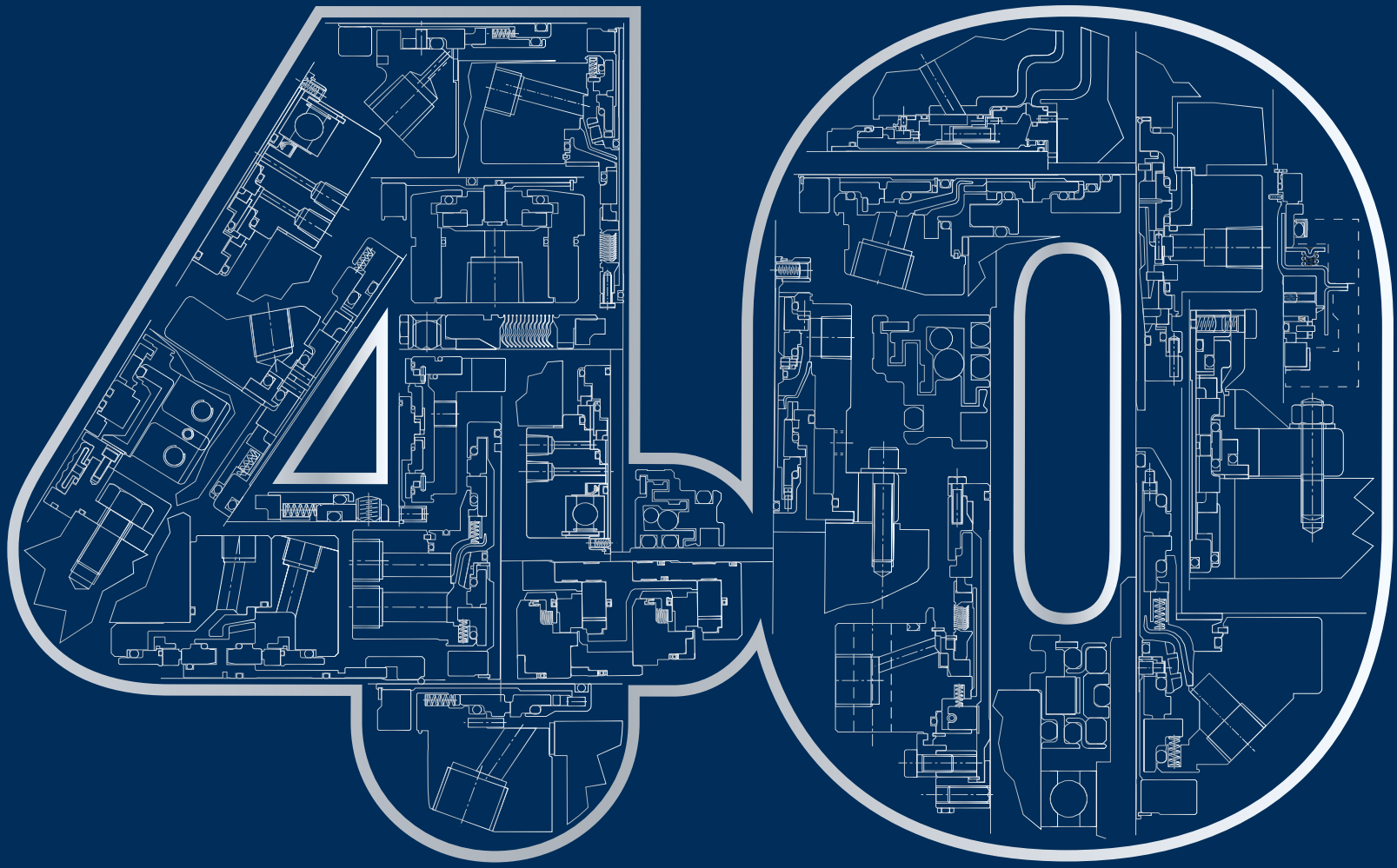


1979 2019

AESSEAL®

EXPERIENCE THE EXCEPTIONAL

Experience the Exceptional

Since 1979, through hard work and determination, the small business we now know as AESSEAL® has thrived. Learning along the way, we did what we could; what we didn't know we had to find out, and where we couldn't be the best, we employed the best. The success of AESSEAL®, I believe, is very much down to:

- The commitment to provide the best customer service: our ability to consistently provide seals faster than our competitors and back this up with a genuine desire to do the right thing, has won us many customers.
- Investment in innovation: over the last 40 years we have developed from nothing a complete range of mechanical sealing products, many of these designs have patented features that ensure a more reliable solution, saving our customers both time and money.
- Conducting our business in an ethical manner and being a good corporate citizen.

This is underpinned by a never ending desire to continuously improve. Whether it's our products, processes, facilities or our people, AESSEAL® has a reputation as a challenger brand, unafraid to question the status quo. We constantly innovate and invest to achieve growth and profitability. Some say that, for the size of the business, the investment is too much, but I believe that through this continuous investment in our assets, both in machinery and in people, our success will prevail. Part of this is also because we are a business of trust. We champion trust through uncompromising integrity and completely transparent business activities in every country where our products and services are supplied.

I recognized many years ago that to grow the business I would need to find good people. I have been very fortunate to find many exceptional people who, in return for being given the authority to carry out their role, have completely immersed themselves in the ethos of AESSEAL®. Without these people, AESSEAL® would not be where it is today. I hope you enjoy this book giving a short overview of some of the areas that have contributed to the success of AESSEAL®. I believe the next 40 years will be just as rewarding.

C. J. Rea OBE, BSc, CEng, FIMechE, DL
Managing Director

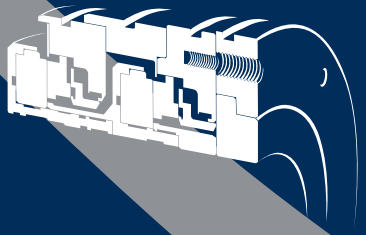
Contents

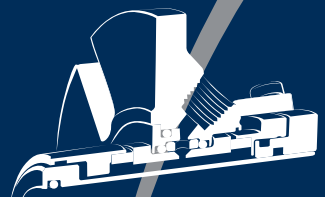
1988

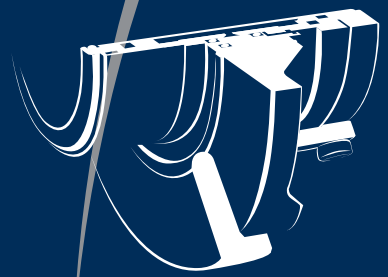
A.E.S wins the Queen's Award for Technological Achievement for the Universal Self-Aligning component in its mechanical seals

2002

Bearing protection launched

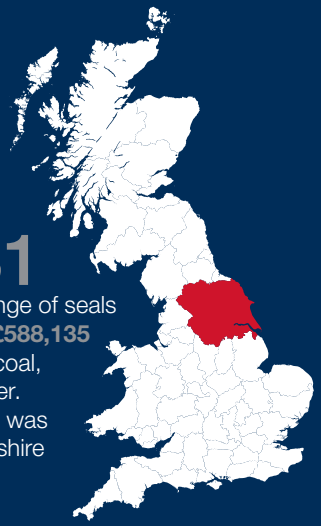


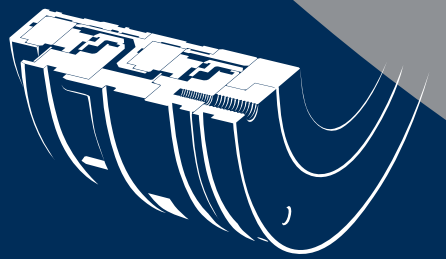




1981

Modular range of seals launched, **£588,135** in sales to coal, steel & water. The market was South Yorkshire





2004

Compressor dry gas seal technology developed

1979

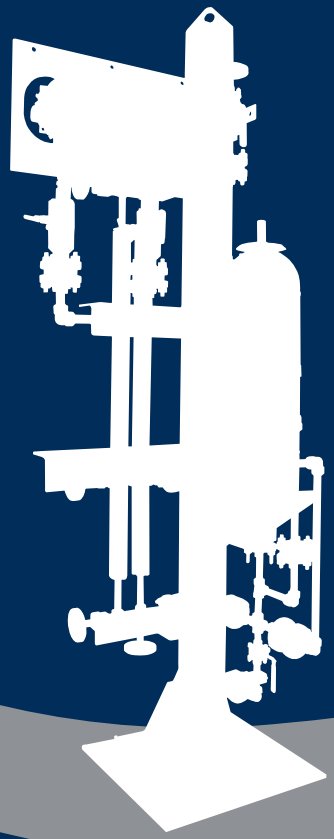
A.E.S is founded and has **5** employees

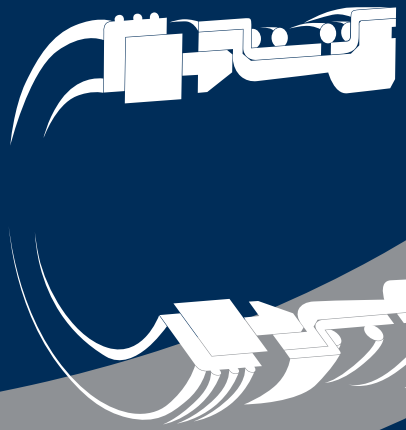
AESSEAL® is the Largest Homogeneous Mechanical Seal Company in the World

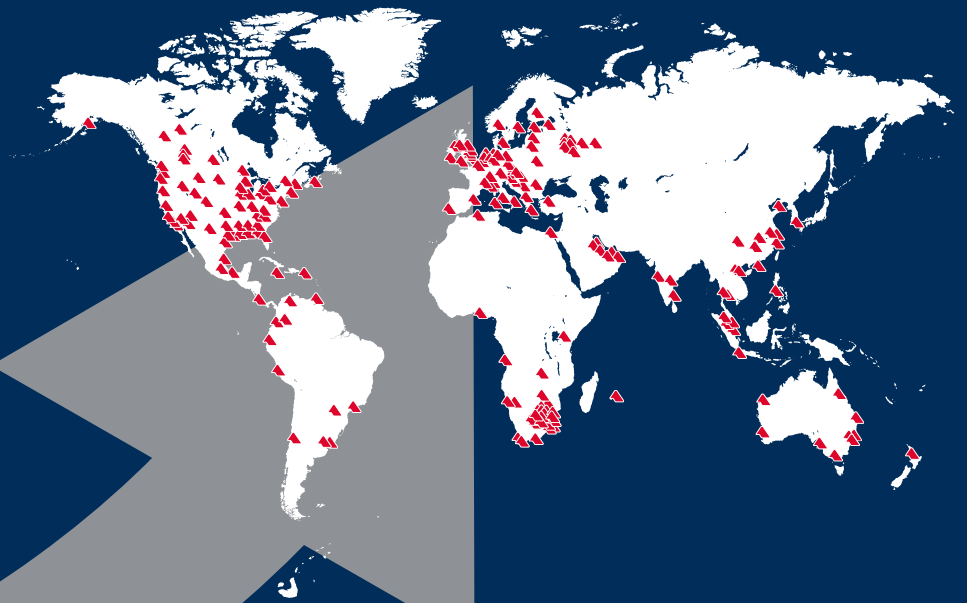
Today AESSEAL® sells to **110** countries

1850 employees, including over 100 apprentices in the last five years

£181m in sales (grown from £35m in 2002)







2008
Modular seal support systems launched

2015
Own component seal range launched

Experience the Exceptional in the Oil & Gas Industry

Oil & gas is one of the most important industries in the world.

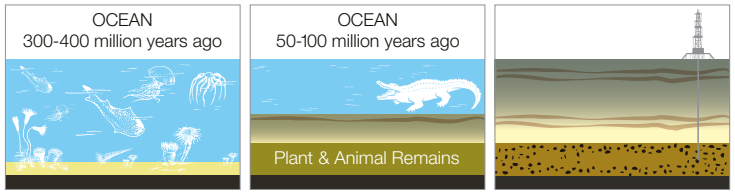
From fuelling your car and heating your home through to plastic items, these all require products produced from the oil & gas industry. These products all come from one raw material, crude oil, which is extracted from deep under the ground, or from the depths of the ocean. The demands of the oil & gas industry have led to strict international standards for sealing technologies. Almost universally embraced by the sector, these standards are set by the American Petroleum Institute (API), and apply to the design and supply of all mechanical seals and associated support products. AESSEAL® works extensively in this industry; all products comply with API standards and help improve reliability in this important industry.

Did you know…?

The term 'oil reserves' refers to the amount of oil in a reservoir that can be technically and economically extracted.

What are crude oil and natural gas?

Crude oil started its life millions of years ago as small plants and animals such as algae and zooplankton. These organisms died and collected on the sea bed. Over time, they became buried with sediment and were subjected to pressure and heat causing a chemical change to take place, forming oil and natural gas. The oil and gas then flow through pores in the rock until they become trapped in a pocket; this is where we find 'liquid gold' today, some 350 million years later.

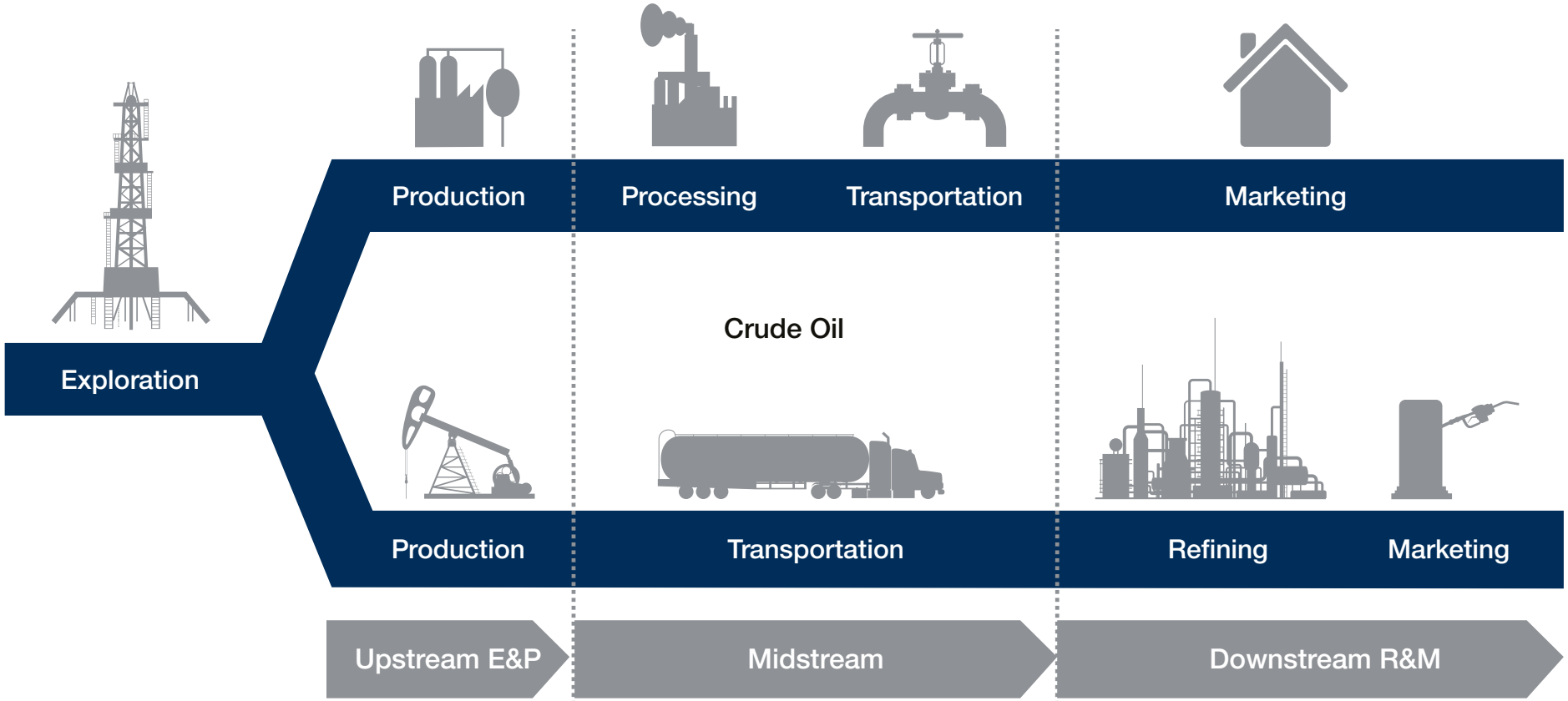


Production process

The oil & gas industry can be broken up into three major processes:

- Upstream – Is the exploration of new crude oil and natural gas fields, drilling exploratory wells and the drilling and operating of wells to recover crude oil and natural gas.
- Midstream – Is the transportation of the raw material either by pipeline, oil tanker, rail or truck. The crude oil is separated from the natural gas, and the natural gas is piped to market. Crude oil is transported to refineries to be processed further.
- Downstream – Is the refining of crude oil to make useful products such as fuel and chemicals which feed the petrochemical industry.

AESSEAL® supplies products to all stages of the production process.



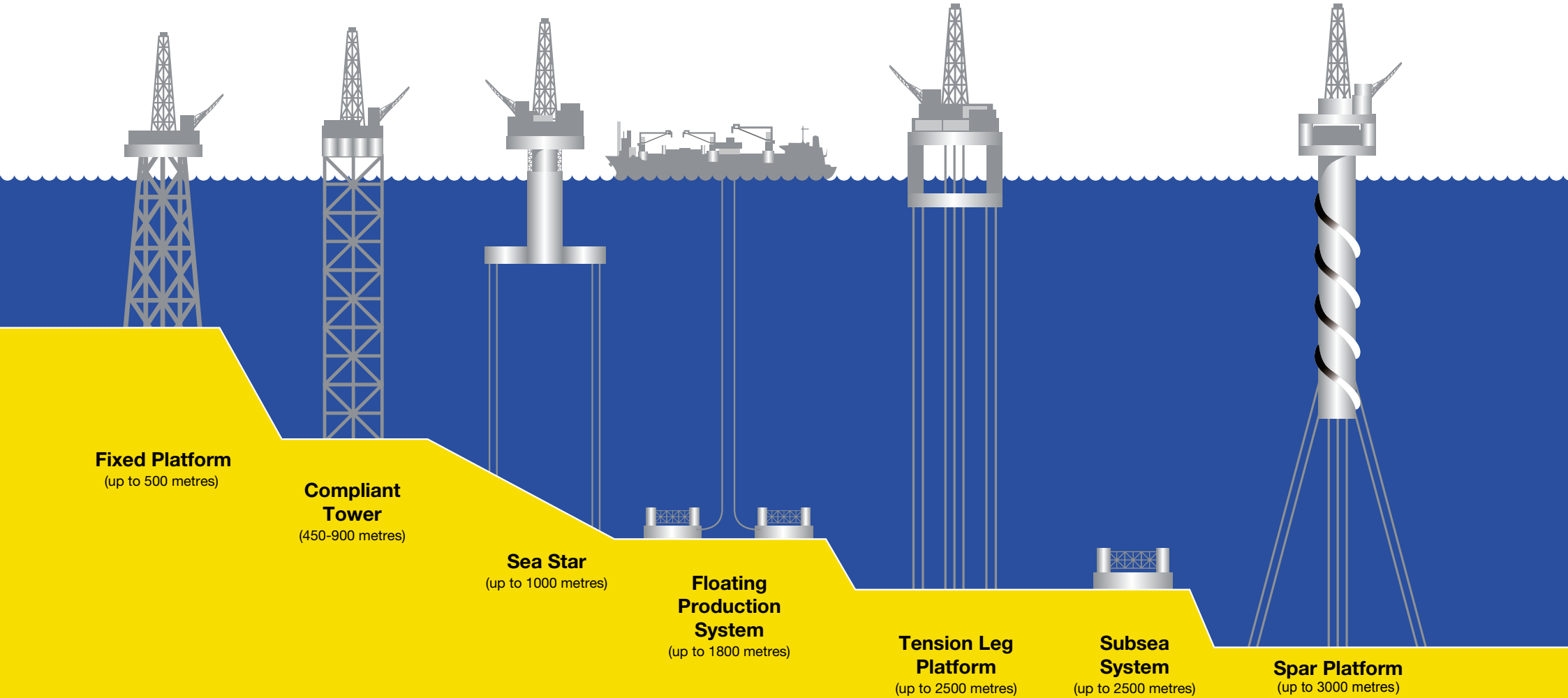
Upstream

Locating

Finding crude oil and natural gas is a time consuming and expensive process. Companies spend millions of pounds before they strike 'liquid gold'. Geologists and geophysicists use seismic surveys to predict where the next oil field may be. If successful, the location is noted and plans are put in place to extract the crude oil and natural gas from the area.

Extracting

Once oil or natural gas have been located the extraction process can begin. Offshore, drilling into the seabed is necessary in order to access the pockets of crude oil or gas. Oil discovered offshore means drilling is more challenging and often requires a bigger initial investment due to the elongated timeline from initial start up to extracting, whereas onshore, drilling can often extract within a matter of months. There are several different types of offshore oil rigs and the type used depends on the depth of the sea in which they need to drill.



Recovery

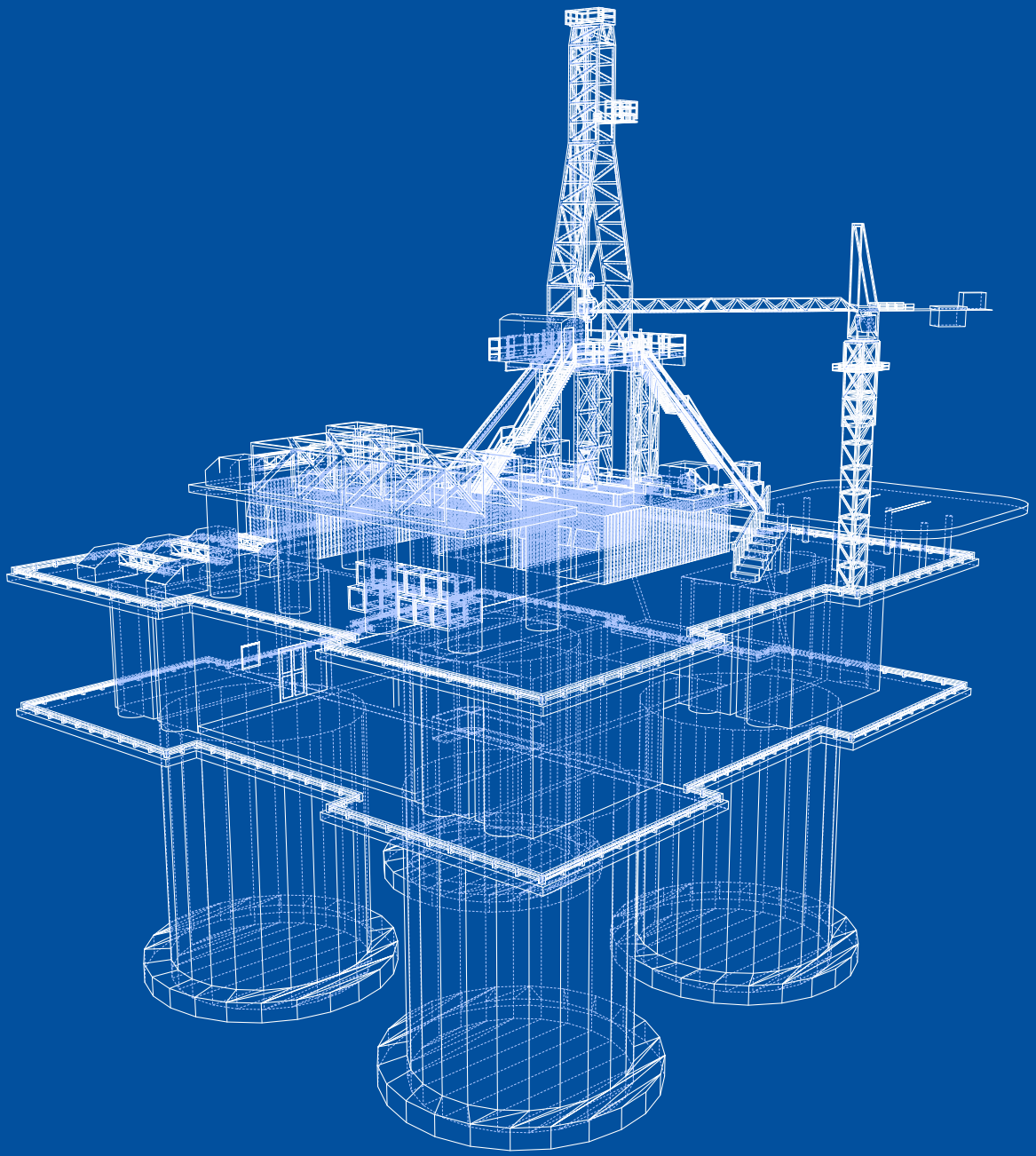
Recovery of crude oil and natural gas happens in three stages: primary recovery, secondary recovery and enhanced recovery.

Primary recovery stage – The crude oil is forced to the surface by natural mechanisms, which include natural water displacing the oil and forcing it to the surface, expansion of the natural gas trapped in the crude oil, and gravity. All of these natural mechanisms help bring the oil to the surface where the flow is regulated by a series of valves and stored ready for processing. Recovery factor at the primary recovery stage ranges from 5 to 15%. Artificial lifting mechanisms are sometimes needed to bring the oil to the surface. These include beam pumps and electrical submersible pumps.

Secondary recovery stage – Over time, the natural pressure subsides and an external energy source is required to force the oil to the surface. This can be done in a few ways; a common method is water injection which requires pumping water into the well at high pressures to force the oil to the surface. Gas reinjection is also used to achieve the same result. Recovery factor at the secondary recovery stage ranges from 35 to 45%.

Enhanced recovery stage - This stage uses methods which reduce the oil's viscosity allowing it to flow to the surface. One method is injecting steam into the well to heat up the oil and lower its viscosity. Another method is burning some of the oil in order to heat the surrounding oil, again lowering its viscosity. Recovery factor at the enhanced recovery stage ranges from 5 to 15%.

Injecting the well with either water or gas requires some very high performance pumps to produce enough pressure to encourage the oil to the surface. AESSEAL® supplies a range of high performance mechanical seals to seal these pumps and is continuously improving seal performance to seal ever increasing pumping pressures and speeds.



Downstream

Oil refinery

Refineries convert crude oil and natural gas into useful and saleable products. There are as many as 2300 different products that can be processed and are then used in:

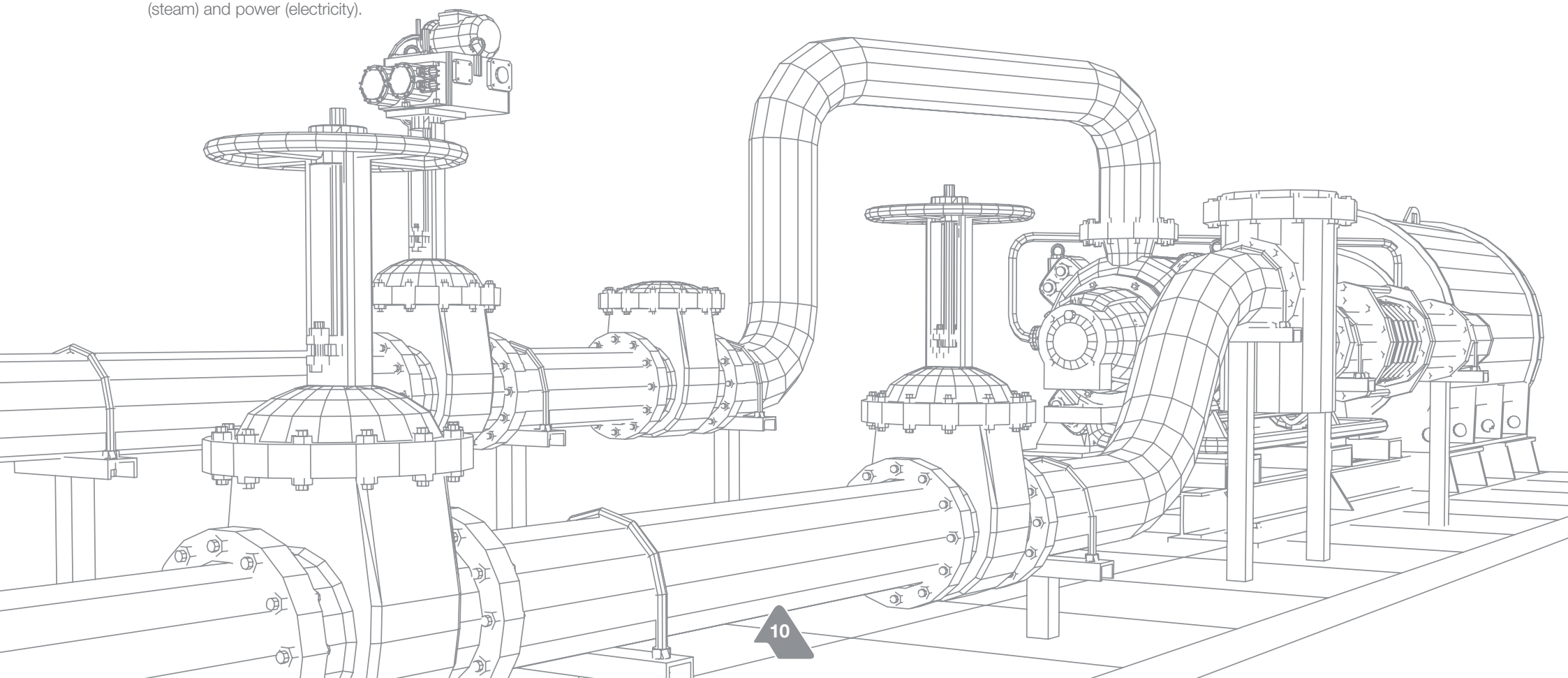
- Fuels for vehicles, aeroplanes, ships and other forms of transport.
- Combustion fuels for the generation of heat and power for industry and households.
- Raw materials for the petrochemical and chemical industries
- Speciality products such as lubricating oils, paraffin, waxes and bitumen.
- Energy as a by-product in the form of heat (steam) and power (electricity).

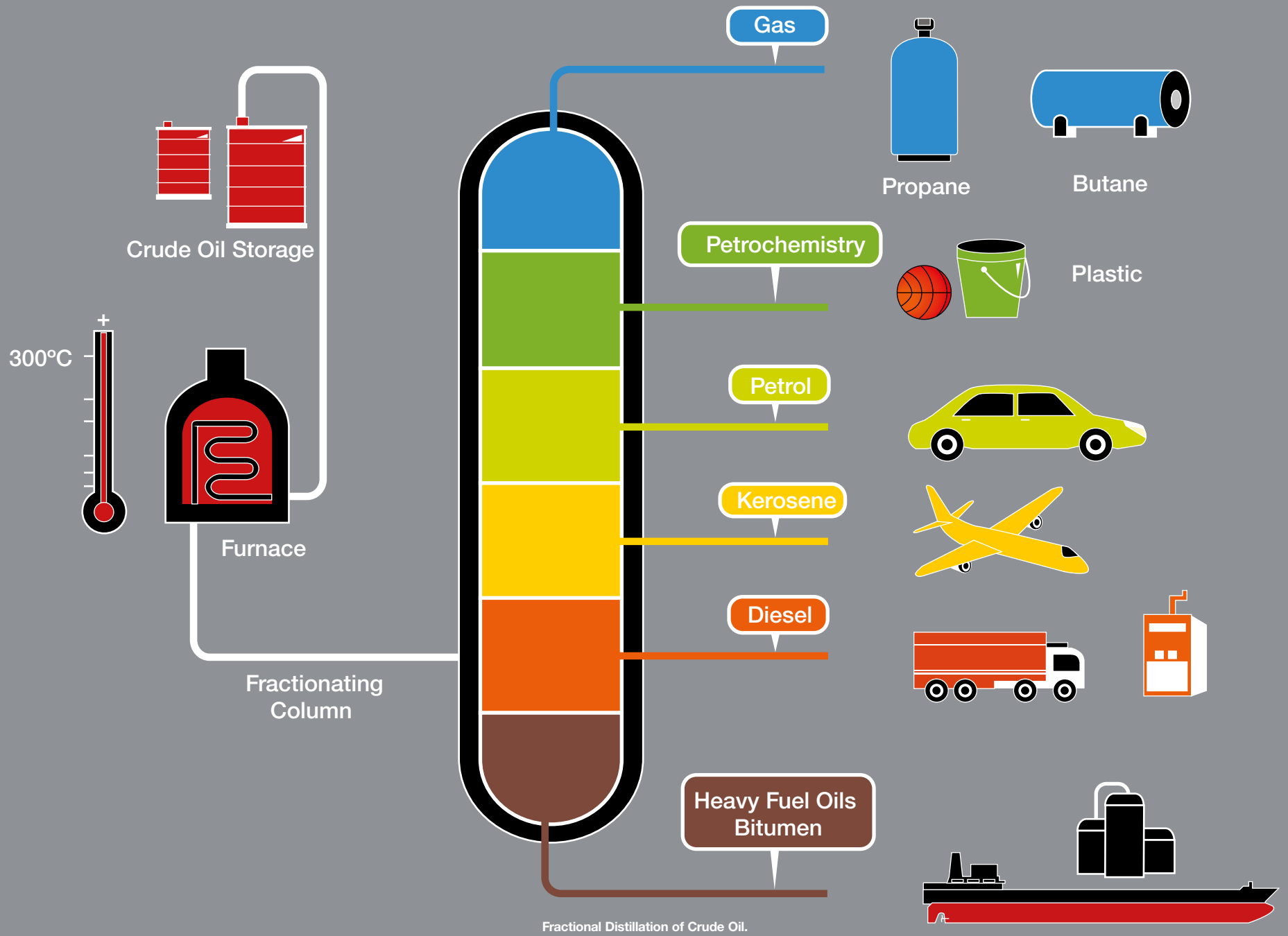
Refining process

Refineries often appear both complex and intimidating, although the core process is actually fairly simple. It involves heating up the crude oil and pumping it to a distillation tower where the lighter, less viscous and low boiling point product travels to the top of the tower (see illustration opposite). The heavier, more viscous and high boiling point products stay at the bottom of the tower. At various points in the tower the products are pumped away.

Pipes and pumps

Refineries look so complicated because they contain miles of pipe connected by pumps moving the crude oil and by-products to different areas of the refinery for further processing. A single plant can contain 700 pumps or more. This is 700 pumps which will require at least one mechanical seal, or 700 motors and gearboxes which require bearing protection. The sheer volume of applications on a refinery, coupled with the thousands of refineries around the world, is why the oil and gas industry is so important to AESSEAL®.



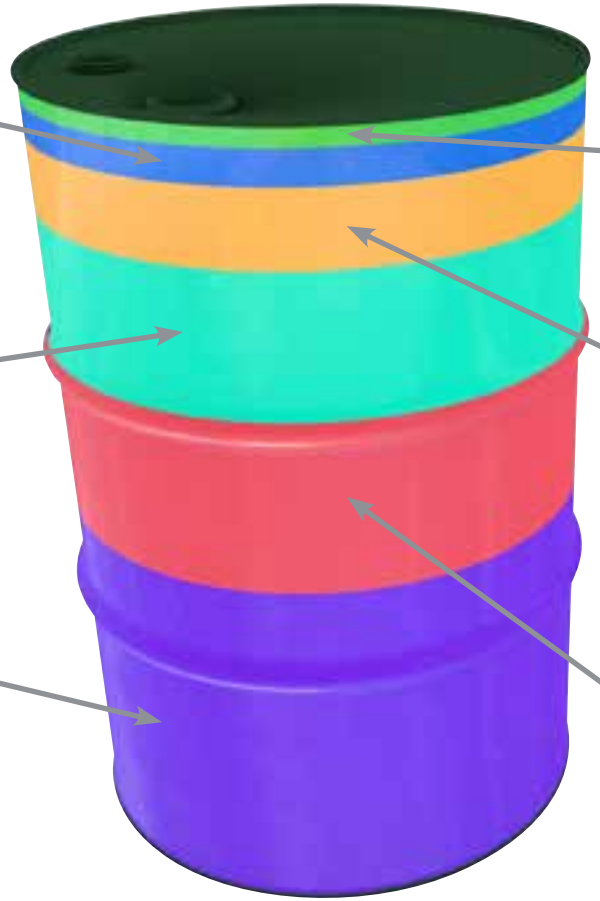


Fractional Distillation of Crude Oil.

A Barrel of Crude Oil

A typical barrel of crude oil holds 42 US gallons and is refined into many products. This makes crude oil a very versatile and important raw material.

In 1979 the world was producing approximately 65 million barrels of oil a day. 40 years later the world is producing more than 96 million barrels a day. So in the lifetime of AESSEAL®, oil production has increased by over 47%.



4% LPG

Liquid Petroleum Gas (LPG) is a mixture of propane, butane and ethane. This is used for transport, heating, cooking, and as feedstock for the petrochemical industry.

18% naphtha, waxes and lubricants

Much of this is used as feedstock for the petrochemical industry.

47% gasoline or petrol

Used in the transportation industry fuelling automobiles.

3% asphalt and bitumen

This is used to make tarmac for roads and also used in roof coverings. This is a very heavy thick black substance.

10% jet fuel

This is the fuel used by the aviation industry.

23% diesel fuel and heating oil

Used in the transportation industry fuelling cars, trucks, ships and heavy construction equipment. Also used in electrical generators and heating.

40 Years

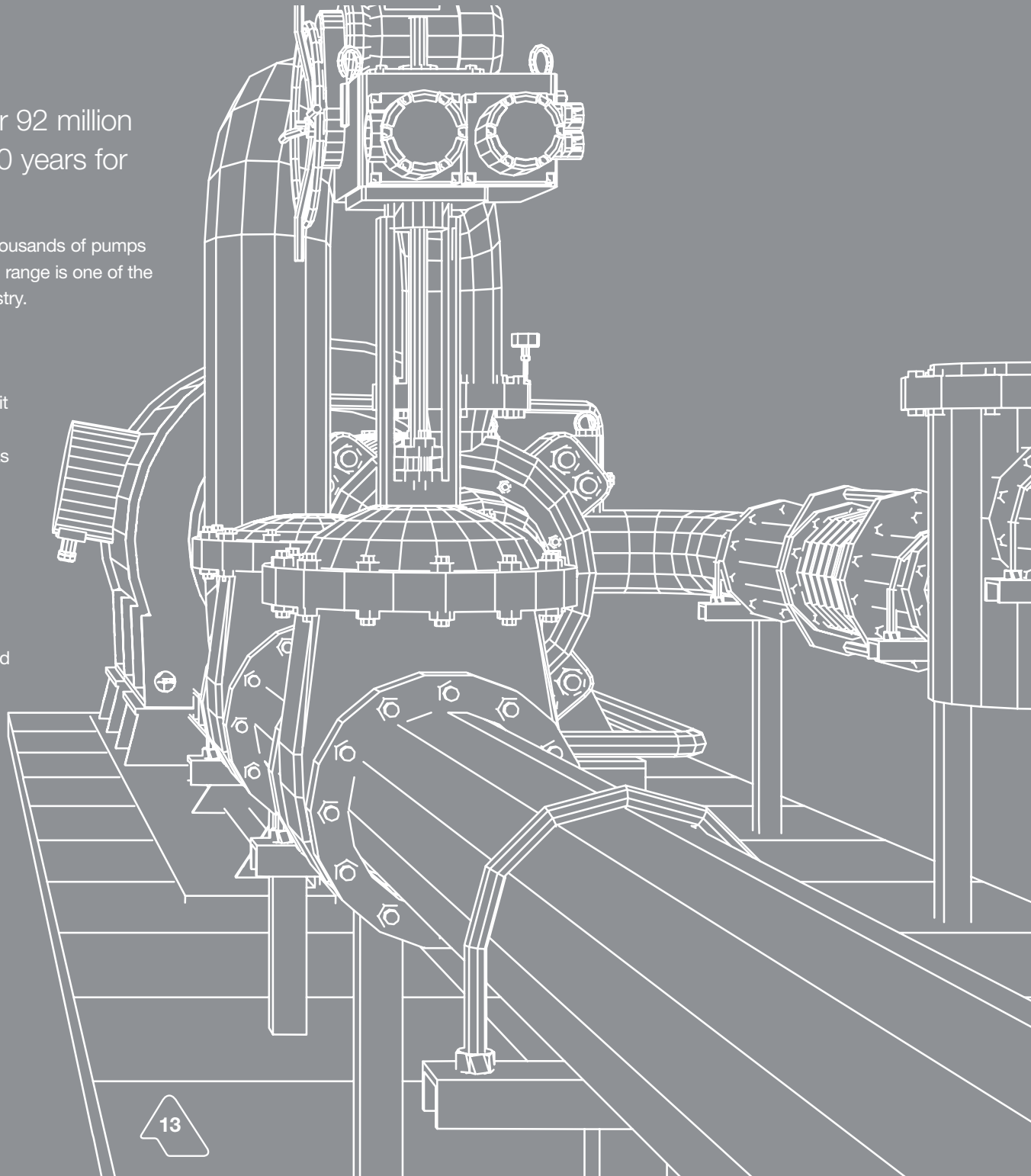
From the oil crisis of 1979 to producing over 92 million barrels of oil a day, much has changed in 40 years for the oil & gas industry.

AESSEAL® has developed a full range of mechanical seals for the thousands of pumps used in the processing of crude oil and natural gas. The CAPI™ seal range is one of the market leaders and widely used in the oil, gas & petrochemical industry.

Next 40 years?

The oil and gas market is producing more than it ever has, however it is a market that is in decline, mainly due to environmental pressures causing a shift to more renewable resources. Despite this, oil and gas will still remain a large and important market. In future, the industry will be looking more than ever for ways to reduce production costs to ensure a profitable business. AESSEAL® is investing heavily in a standardization and automation project in order to respond to the market needs.

As the world's supply of good quality crude oil is running out and poorer quality crude oil is processed, the refineries are forced to run processes differently. This often means the pumps are exposed to increased temperatures, speed and corrosion, which in turn, affects the mechanical seals. AESSEAL® continues to invest heavily in researching new technology, materials and manufacturing processes to keep up with the ever-increasing demands of the industry. Many changes will happen in the next 40 years, but the chances are the oil & gas industry will still be important and AESSEAL® will continue to invest in new technologies to ensure it stays one step ahead of the industry and its competitors by providing the most advanced reliable seals.



Improving Reliability and Increasing Efficiency

A leading refinery in the UK had seal leakage from existing carbon box technology on their 150#, 600# steam turbines. Based on prior experience, the refinery approached AESSEAL® for an alternative solution.

Working with the customer on the design and subsequent test program, AESSEAL® developed a solution for the application. After completing the customer-witnessed in-house testing, the seal was installed into a known 'bad actor' on site for a three month trial. After 2 months' successful operation the customer waived the rest of the trial and placed orders to install identical seals on two more steam turbines with a view to convert all the steam turbines on site.

Steam loss is a major problem on a refinery as it incurs considerable costs. A significant benefit of the new seal is that it has eliminated steam leaks previously present; this represents a significant saving for the customer because:

- The refinery has approximately 150 steam turbines, meaning the cost of steam has a major impact on the profitability of the business.
- There is a health and safety issue as the steam produces a veil which affects vision, causing a potential problem when working on or around the turbine.
- There is an environmental impact caused by the burning of extra fuels.
- Steam leakage also contaminates the bearings' lubrication, causing them to fail prematurely.

Cost of steam loss from a single turbine:

Total cost of lost steam per steam turbine per year is approximately £15,000.

Potential saving to the refinery with all the 150 steam turbines fitted with steam turbine mechanical seals is
£15,000 x 150 = £2,250,000 per year.

Without Steam Turbine Seal.

With Steam Turbine Seal.

Steam Turbine Mechanical Seal

Industry:
Oil & Gas

Application:
Steam Turbine

Savings:
£2,250,000 / Year

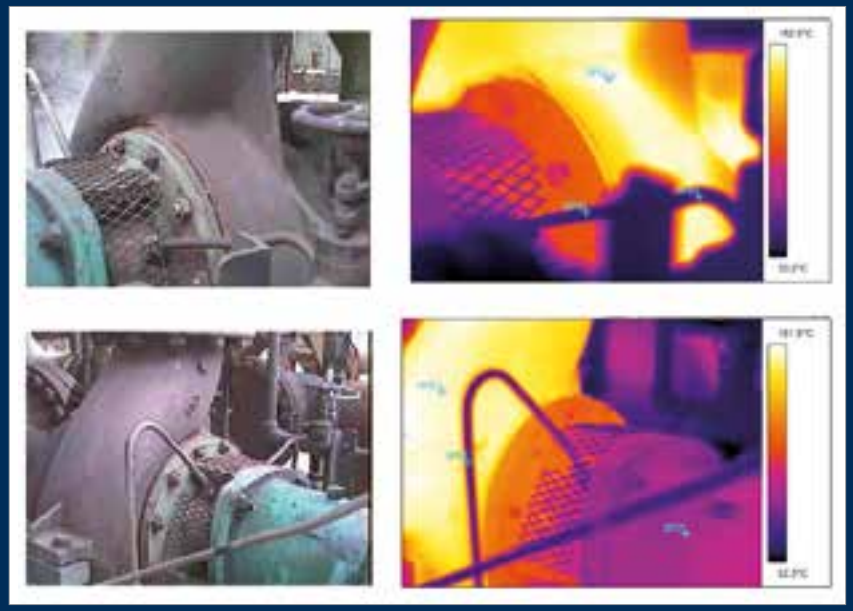
Reference N°:
CH01446

Reduced Maintenance Through Improved Reliability

A major oil refinery in South Africa had an unreliable mechanical seal on a cooler water pump. Despite competitors trying a number of different seal support system configurations, the seal was failing approximately every six to nine months.

This was as a result of dry running, causing vaporization, damaged elastomers, seal face wear and pump bearing failure caused by heat transfer. AESSEAL® installed a CAPI™ A Type 23 mechanical seal along with an API Plan 23 seal support system, utilizing a double Python cooler. The new solution eliminated the need for frequent maintenance and has been operating for over 54 months. Subsequently, the customer upgraded eight similar pumps on the plant.

"With the good performance of the seal and Python cooler as a combined solution, we could afford to do the upgrades on the eight units from our maintenance budget in two years. The pump bearing temperatures drop by about 20°C and run at 65-80°C."
Mechanical Rotating Equipment Group Leader



CAPI™ A Type 23 Single Seal With API 23 Seal Support System Using Double Python Cooler

Industry:
Oil & Gas

Application:
Cooler Water

MTBF Increase:
500%

Savings:
£343,000

ROI:
<10 Months

Reference N°:
CH01447

Experience the Exceptional in the Mining & Minerals Industry

AESSEAL®'s unique modular technology enables it to respond quickly and effectively to even the most demanding technical challenge or deadline.

AESSEAL® is a mining industry pioneer with a total focus on achieving exceptional quality in terms of products, technical innovation, customer service and product support. Its seals deliver increased reliability and reduced cost of ownership, and it has the evidence and customer references to prove it. AESSEAL® delivers exceptional service and exceeds expectations. Everything it does – from manufacturing to distribution and product support – is focused on redefining the customer experience.

The mining industry poses some specific difficulties sealing pumping applications. The pumped product is typically highly abrasive and customers are often in difficult to access areas. The unique modular technology ensures that AESSEAL® can respond quickly and effectively. AESSEAL® has sealed some of the most demanding applications in this industry.

Did you know…?

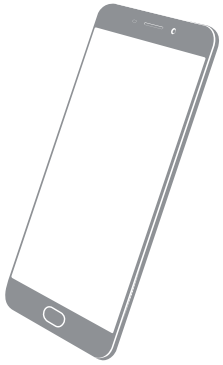
The term 'Luck of the Irish' dates back to the gold and silver rush in the 1800s and refers to the most famous miners being of Irish descent.

Mining Impacts Your Life More Than You Realize

Millions of essential products require materials harvested from the very planet we inhabit.

There is a wealth of naturally occurring resources residing beneath the Earth's surface. Products ranging from the cars we drive and the mobile phones we use contain thousands of minerals from mines around the world. Metals including copper, nickel, lead and zinc, as well as precious metals such as gold and silver, are present in rock or sediment in the form of ore. This naturally occurring material is harvested from the earth by mining. This ore can then be refined using various methods to extract the valuable material. All products in modern society rely on the use of minerals and metals in their production.

Could you live without your mobile phone?



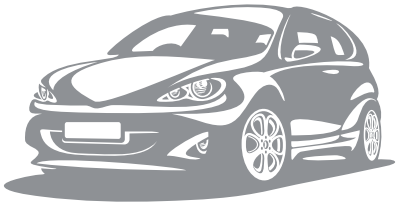
Did you know that without minerals and mining the devices that we have become so reliant on would not exist? There are a large variety of minerals that make up the main components of our mobile phones including the screen, battery and processor.

Lithium, cobalt and manganese are some of the materials that make up the battery. The processor is made from silicon bombarded with other elements including phosphorus, arsenic and boron. The LCD screens consist of aluminium and silicon.

Metals and minerals drive the automotive industry

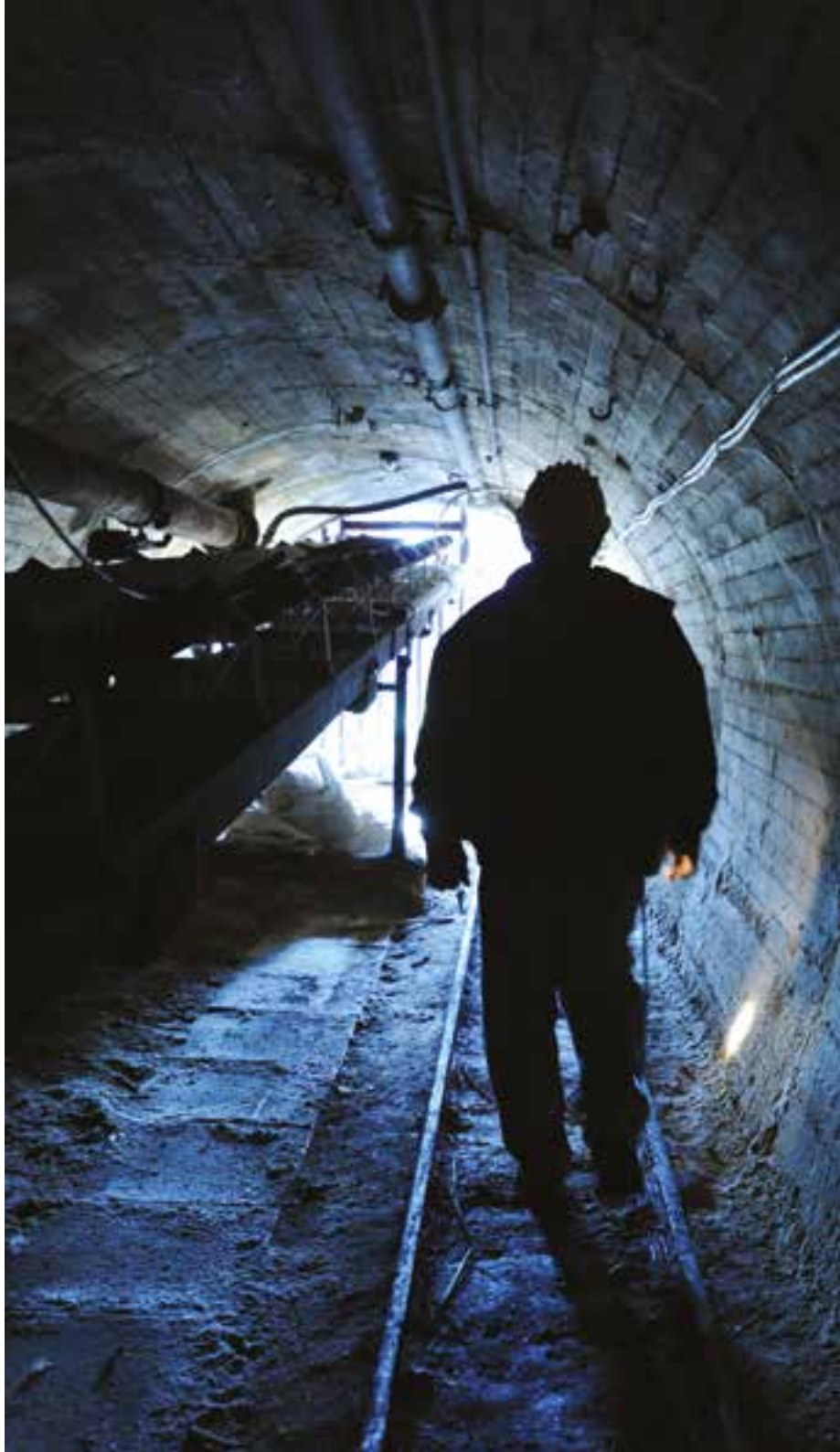
Since the mass production of cars in the 1920s, they have greatly impacted the way we live our lives, becoming the most widely accepted method of transportation with millions of people relying on them for their everyday commute.

Car chassis are typically made from steel or aluminium alloys. Steel is an alloy of iron and carbon; both aluminium and iron are mined in the form of ore. Badges and door handles are coated in chromium that comes from the naturally occurring mineral chromite. A car battery contains approximately 11kg of lead.



Mining process

The process of mining a mineral depends on where the mineral naturally occurs. Coal, for example, can be mined from the surface or from deep underground. The process of mining can leave the land unsightly with open pits and large amounts of waste rock.



Mining and the Environment

Mining is undeniably essential to the way we all live our lives, but not all results of mining are desirable…

Air

Mining disturbs the earth and exposes material usually below the surface. This material can often contain unrefined toxic particles such as lead, cadmium and arsenic. The release of these elements into the air can result in respiratory problems for those living near mining activities.

Land

Removal of the land can leave unsightly results including open pits and waste rock. Areas of beauty are degraded to ugly scars on the landscape. Even when remedial work is done, many of the natural features of the land are lost forever. Land removal can also cause subsidence in the surrounding area causing damage to roads and buildings.

Water

Water pollution can be a result of processing plants, tailing ponds, and underground mines. Mining results in unnaturally high concentrations of chemicals such as mercury, arsenic and sulfuric acid over a significant area surrounding the mine. These chemicals are washed into our lakes and streams by rainfall and have negative impacts on marine life and local domestic water supplies.

Biodiversity

Mining has a huge impact on the landscape and destroys local wildlife habitats. Trees, hedges and fields are amongst other natural features where animals live that are cleared to begin mining operations. Loss of these habitats can result in loss of species in particular areas. More subtle impacts on the surrounding area such as changes to the pH of the soil due to the unearthed minerals can affect plant life; some plants will cease to exist in an area which may be a main food source for some species of animals. The impacts of mining have serious effects on the surrounding eco-system.

Water, pumps and sustainability

The mining industry is one of the most arduous and expensive industries for the maintenance of rotating equipment. Not only must it deal with abrasive and corrosive applications, but it also has to accommodate historical ‘run-to-failure’ maintenance practices and the difficulty of operating in remote locations. A common mining industry misconception is that the only way to achieve a reliable seal on these tough pumping applications is through the use of gland packing. However, gland packing goes hand in hand with high water consumption, high maintenance costs, poor equipment availability and large production losses.

Not only do mechanical seals work in the mining industry, they are collectively eliminating billions of gallons of wasted gland water each year, while simultaneously improving the MTBR (Mean Time Between Repairs) of the pumps. Thousands of double mechanical seals are now operating successfully around the globe in some of the most remote and difficult phosphate, platinum, gold, potash, copper and other mineral extraction operations. This has been made possible by simply following the golden rule of sealing: “maintain a stable fluid film”.

Typical mining slurry pump with packing gland water can create a safety hazard and waste water.

Sustainability

AESSEAL® products play a key role in the mining industry, saving water and eliminating contamination of the environment.

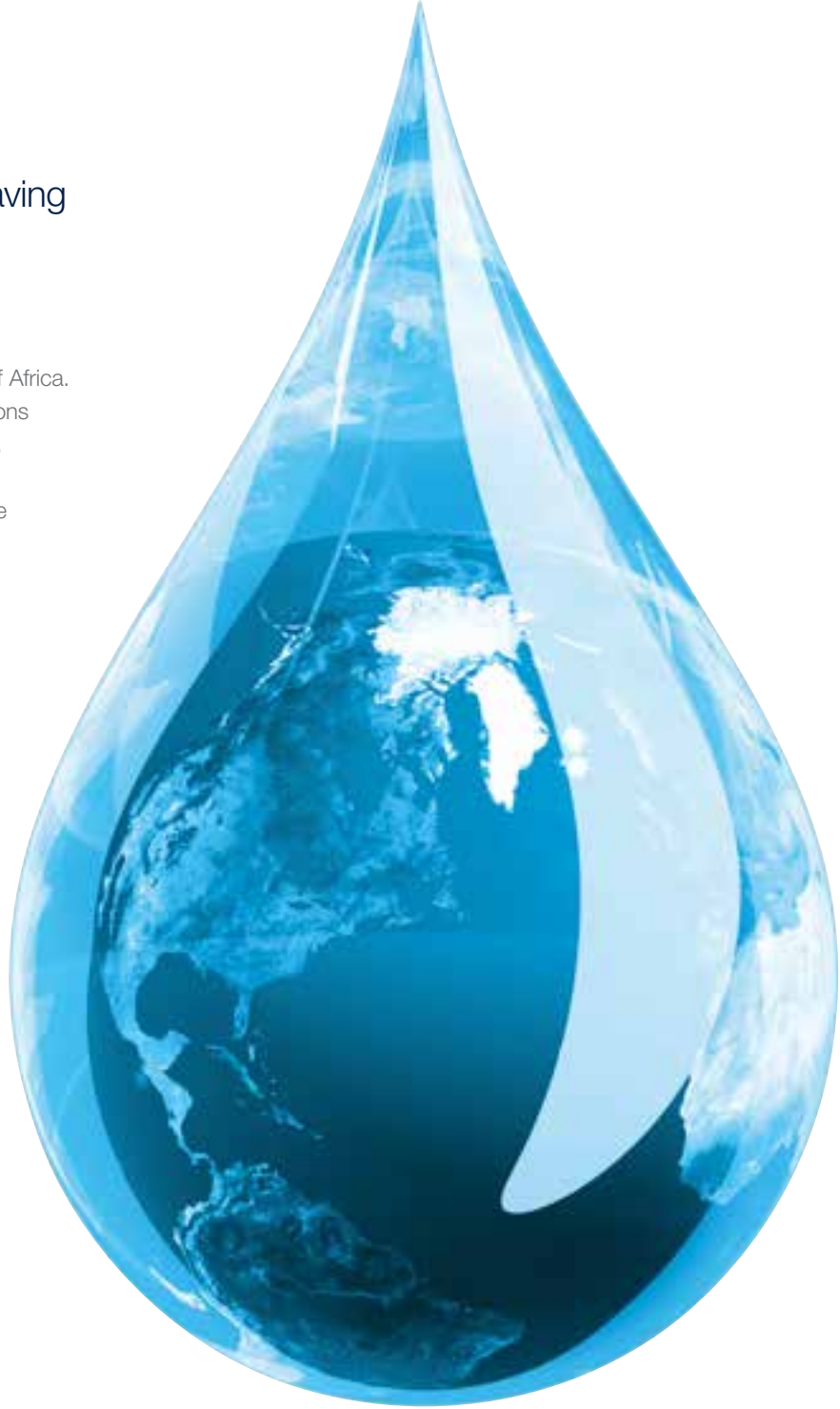
Saving over 1 billion US gallons of water

The largest diamond mine in the world (Debswana Orapa) is located in an extremely arid region of Africa. The mine's Warman® F-frame pumps were sealed with gland packing, which required 19 US gallons (71 litres) per minute of gland water per pump. The company turned to AESSEAL® for assistance, which recommended fitting double mechanical seals along with a water management system to the 18 Warman® 6x4 E-frame and 12x10 F-frame slurry pumps. After seven years in operation the seals were still running well with reported water savings of 1.1 billion US gallons (4.1 billion litres), which has a value of $3.9 million.

Eliminating environmental impact

A coal mine in Australia was using gland packing in its coal slurry pumps, which had a MTBF (Mean Time Between Failures) of 4-6 weeks. The leakage from these packed pumps was causing the tailings dam to overflow into a nearby river: this leakage needed eradicating or the company would be liable for a heavy fine and associated clean up costs. AESSEAL® installed a heavy duty slurry seal (type HDDSS™), a water management system (type SW2™) operating in an API Plan 53 configuration, and a stainless steel filter. The HDDSS™ is a back to back double seal, specifically designed for Warman® pumps. The cooling water on this plant contained small amounts of magnetite and slurry so the filter was key to ensuring that the seal was flushed with clean water.

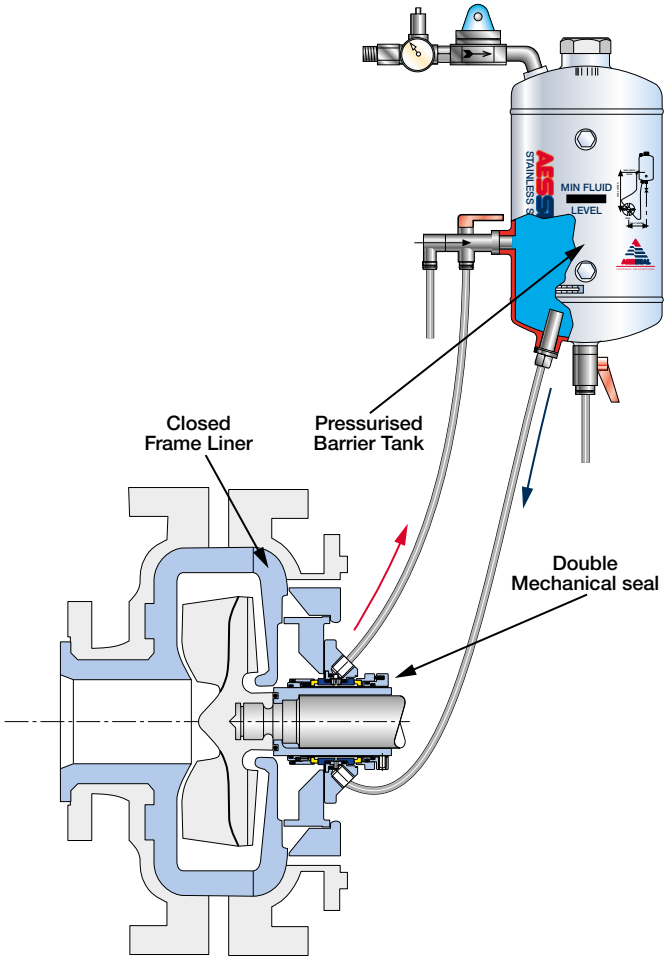
In addition, the cooling water pressure was variable so the SW2™ system with its non-return valve ensured that the seal received a constant flow of flush water. Within one week of installation, the customer saw the advantage of the new seal and subsequently replaced the packing on 30 other installations with the HDDSS™ seal. The upgrade solution eliminated water leakage to the environment, whilst reducing maintenance costs and delivering an 833% improvement in MTBF.



Change the seal environment to extend the life of the seal

AESSEAL® has successfully sealed thousands of slurry pumps, and found that the best way to seal tough mining slurries is to use a double mechanical seal and to change the seal environment through two simple steps:

1. Use a CLOSED FRAME LINER to keep the high-velocity slurry away from the seal, and
2. Use a PRESSURISED BARRIER TANK system to feed clean water to the area between the double seals at a pressure higher than the product pressure, thus creating a clean and stable fluid film for the seal faces.



AESSEAL® recommended slurry-sealing strategy.

Warman® GAH slurry pump with leaking packing gland water, BEFORE installation of mechanical seals.

Below - Same Warman® slurry pump, AFTER installation of double mechanical seal and tank system (circled).

A $1.1 Million AUD Saving on a Coal Slurry Pump

A coal mine in Australia was having seal failures roughly every two weeks on two disposal pumps. The aggressive nature of the coal mine water slurry was not only damaging the competitor seals but was causing bearing failure and large amounts of downtime.

The customer had replaced 24 competitor seals in the previous 12 months and the regular seal failure, bearing replacement and loss of production was causing major issues. In a 12 month period, without including the loss of production, the total maintenance bill was over $1.1 million AUD (over £600,000).

The competitor seals were replaced with 2 AESSEAL® heavy duty slurry seals. The CDPH™ and HDDSS™ seals both have large ports and increased radial clearances to withstand high levels of pump vibration and so can maintain a stable fluid film to extend seal life.

The AESSEAL® seals have currently been running for over 15 months without failure, and have saved the customer over $1 million AUD (nearly £600,000) including the purchase of the seals, and increased the Mean Time Between Failures to 2900% and counting.

HDDSS™ CDPH™

Industry:
Mining

Application:
Coal Slurry Disposal Pump

MTBF Increase:
2900%
(and counting)

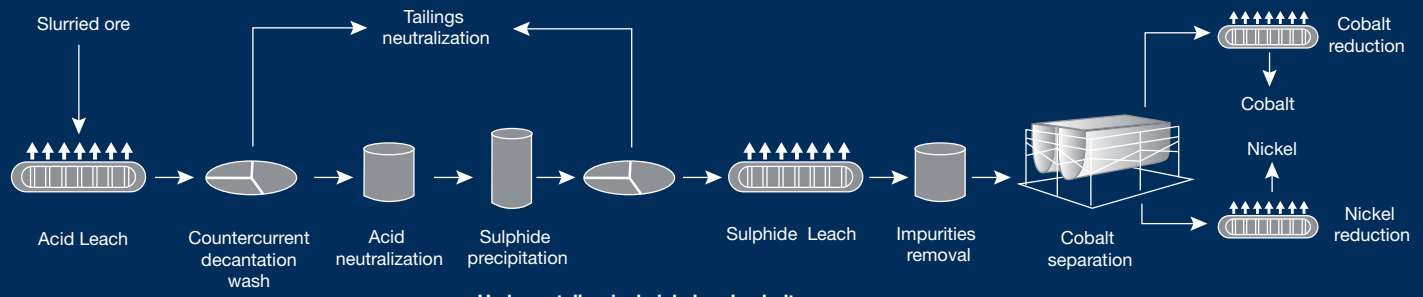
Savings:
$1.1 Million AUD
(and counting)

Reference N°:
CH01346

Autoclaves Case Study

The site has an annual design capacity of 60,000 metric tonnes (66,139 tons) of nickel and 5,600 metric tonnes (6,173 tons) of cobalt.

Slurried lateritic ore is delivered from the mine site via a 220km (137 mile) pipeline to a processing plant and refinery. At the plant site, slurried ore is processed and refined to produce high grade nickel and cobalt briquettes. AESSEAL® was asked to propose solutions for the acid leach, sulphide leach and nickel and cobalt reduction stages.



Hydrometallurgical nickel and cobalt recovery process.

During start-up at the plant there was a broad array of failures. The majority of the competitors' seals leaked immediately on installation, believed to be as a result of tolerance 'stack-up' inside the machine, meaning the seals were never installed at the correct working length. Mean Time Between Failures (MTBF) of the existing seals was declining with a current average of approximately five months.

The AESSEAL® design considered the existing failure modes previously seen on site:

- Lubrication at the seal faces is essential – Demineralized water has poor seal face lubricating properties. This is made worse by the introduction of abrasives due to issues with filtration.
- A stable thermal equilibrium temperature for the seal to operate in is essential to ensure no vaporization of fluid film and thermal degradation of secondary sealing.
- An inconsistent support system for a mechanical seal is a recipe for failure, which would need to be controlled in a more efficient way.

A 7.000" HPVD™ seal design with and/or without the internal flush option was proposed. The flush option would only be recommended if the flush fluid was clean (i.e. free from solids) and maintained at a pressure greater than the product pressure but less than the barrier fluid pressure. The design includes a patent pending feature that ensures the seals can be installed at the correct working length. Despite being a less than ideal solution, the existing centralised demineralized water barrier fluid system is being used for practical reasons.

The AESSEAL® HPVD™ seals provided have proved to be lasting more or less leak free. The MTBF for the AESSEAL® HPVD™ seals installed is 14 months and rising (at the time of writing). A majority of the 35 applications (which is five autoclaves, each with seven agitator seals) were also being sealed with HPVD™ seals. A new AESSEAL® HPVD™ seal cost is approximately 75% of the cost of a competitor repaired seal, which typically leaks from initial start-up. The cost to repair an AESSEAL® HPVD™ seal is half that of the competitors' repair cost.

7.000" HPVD™ Seal

Industry:
Mining

Application:
Industrial Autoclave

MTBF Increase:
300%
(and counting)

Savings:
25%
(cost against competitor seal)

Repair Savings:
50%
(cost against competitor repair)

Reference N°:
AC-2016-1

Experience Exceptional Water Savings

Water is becoming more scarce and more expensive. Still, large quantities of water are essential in many industrial processes.

Accurate water-balance planning and reduction of overall water consumption are critical. AESSEAL® has saved millions of gallons of water per pump per year, while also increasing the MTBR (Mean Time Between Repairs) of the equipment with an ROI (Return on Investment) that is typically six months or less. Case histories show examples across several industries where AESSEAL® products have:

- Eliminated 154 million gallons of wasted water per year.
- Produced savings of $30 million per year of product losses.
- Increased plant availability through elimination of 28 pump repairs.
- Given a three-week ROI for a seal upgrade.

Did you know...?

Of all the world's water 97.4% is salt water, 2% is solid in ice caps and other inaccessible places. Less than 1% is suitable for industrial use and human consumption.

Industrial Wastewater

Mines and quarries

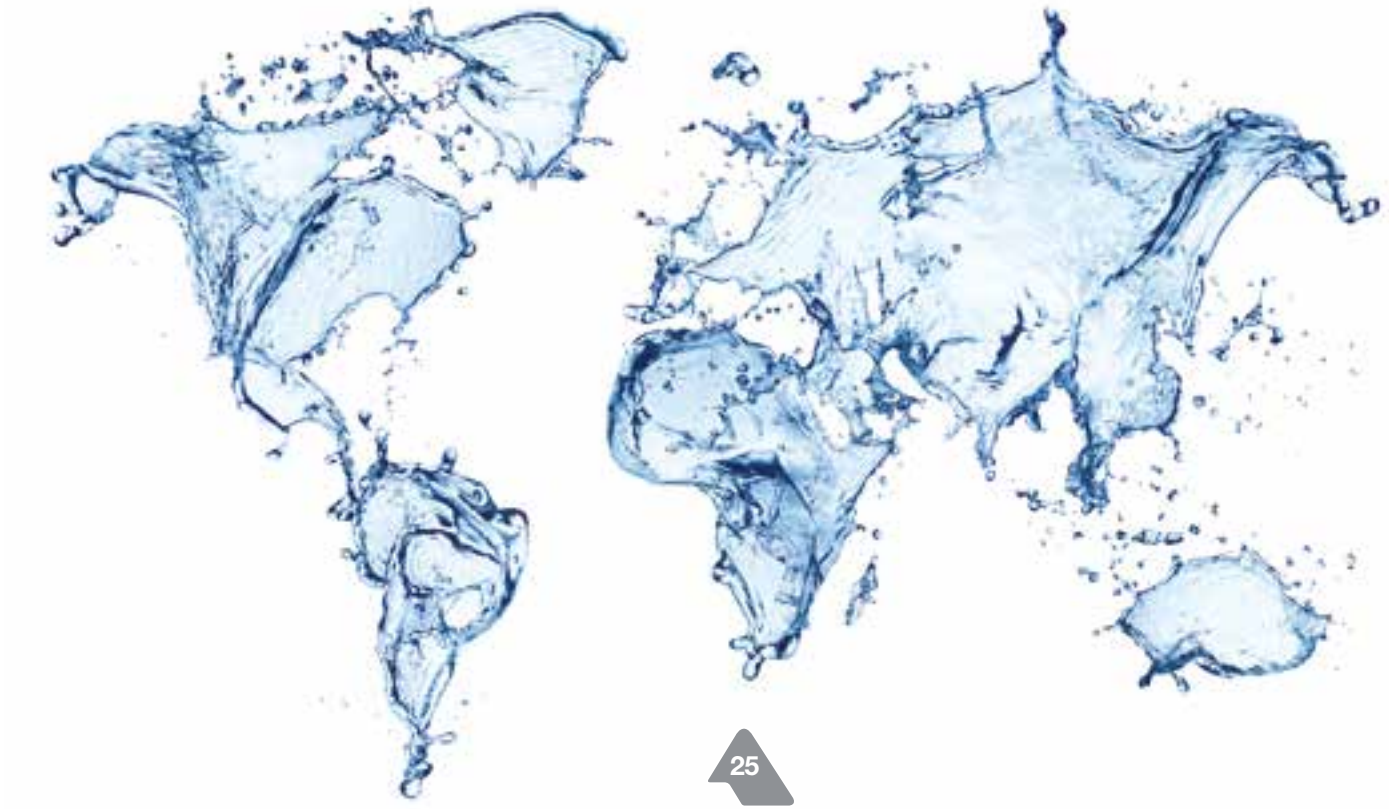
The principal wastewaters associated with mines and quarries are slurries of rock particles in water. These arise from rainfall washing exposed surfaces, haul roads, and also from rock washing and grading processes. The volumes of water used and wasted can be very high, especially on large sites. Some specialized separation operations, such as coal washing to separate coal from native rock using density gradients, can produce wastewater contaminated by fine particulate (haematite and surfactants). Oils and hydraulic oils are also common contaminants.

Food industry

Wastewater generated from agricultural and food operations has distinctive characteristics that set it apart from common municipal wastewater managed by public or private sewage treatment plants throughout the world: it is biodegradable and non-toxic, but has high concentrations of BOD (Biochemical Oxygen Demand) and suspended solids (SS). The constituents of food and agriculture wastewater are often complex to predict due to the differences in BOD and pH in effluents from vegetable, fruit, and meat products, and the seasonal nature of food processing and post-harvesting.

Industrial water and wastewater treatment

Two of the main processes of industrial water treatment are boiler water treatment and cooling water treatment. Water treatment can lead to the reaction of solids and bacteria within pipework and boiler housing. Steam boilers can suffer from scale or corrosion when left untreated. Scale deposits can lead to weak and dangerous machinery, with additional fuel being required to heat the water because of the rise in thermal resistance. Dirty water can become a breeding ground for bacteria such as Legionella, causing a risk to public health. With the proper treatment, a significant proportion of industrial on-site wastewater might be reusable. This can save money in three ways: by reducing water consumption, reducing effluent water discharged, and reducing energy costs by recovering heat in recycled wastewater.



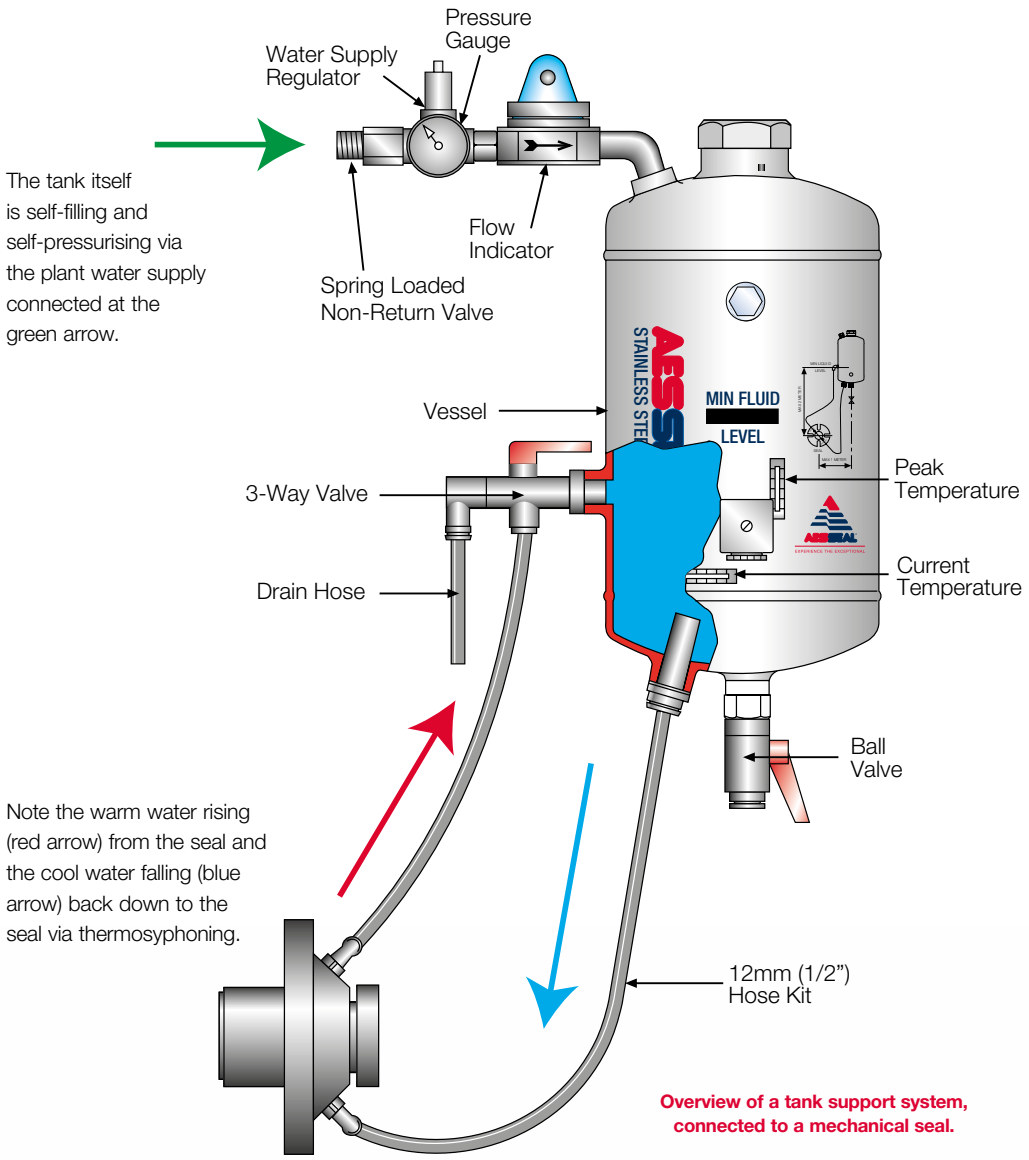
How Water is Saved

A properly designed seal support system supplies a clean, cool liquid (usually water) to the barrier space between the two sets of seal faces in a dual seal, at a higher pressure than the process fluid in the pump.

This pressure differential forces the clean barrier fluid across the faces, forming a stable fluid film, cooling and lubricating the faces. As the mechanical seal faces generate heat, the hot water in the barrier zone of the seal rises to the tank. The tank radiates heat to the atmosphere, and the cooler, denser water sinks back down to the seal. This process is known as a 'thermosyphon', and it enables the tank to provide the mechanical seal with a constant supply of fresh, cool, clean, pressurised water for the fluid film, with no moving parts.

The AESSEAL® SW2™ system uses an integral vessel to store flushing water for continuous recycling. The system is connected directly to the plant water line, which becomes the system's fluid and pressure source. The pressure is adjusted so that it is maintained at 1 bar above the pump stuffing box pressure, resulting in a positive pressure differential, keeping harmful products away from mechanical seal faces and increasing seal and pump reliability.

Mondi, a paper company in South Africa, uses AESSEAL® water management to reduce water consumption. As well as lowering costs by conserving water, the systems are superior to the once-through format in three ways: first, there is an indicator that shows when any inboard seal failure occurs; second, the system is kept pressurised by a non-return valve which helps to prevent cross contamination of sealing water in the event of a failure; third, the system is fitted with a regulating valve which maintains water pressure and flow rate without further settings or adjustments after installation.



Overview of a tank support system, connected to a mechanical seal.

Reducing Water Usage

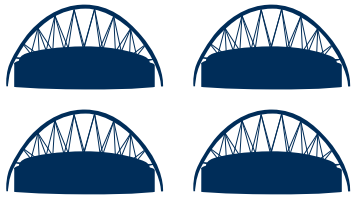
and increasing Mean Time Between Failures.

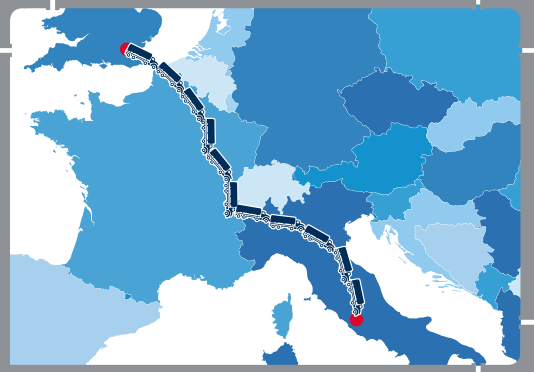
International packaging and paper group Mondi is installing AESSEAL® water management systems at its Richards Bay mill, cutting water use by more than 60,000 kilolitres per month, and helping to conserve scarce water resources in northern KwaZulu Natal.

4.5 billion litres
of water will be saved
in the next six years

4

Enough water to fill
4 Wembley stadiums





6

6 years MTBF Current seals supplied by AESSEAL® have worked successfully for over six years

167

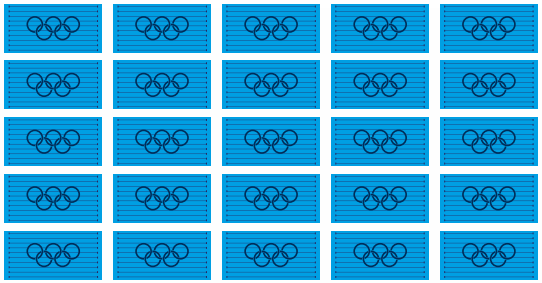
167 AESSEAL® water systems will be installed in Mondi's Richards Bay operation following Mondi's successful trials of 152 such systems installed over the last 12 years

<1 Year Payback period for the installation of 167 water systems

1

25

Enough water to fill **25 Olympic swimming pools EVERY MONTH**



1185

If the water was in oil tankers the tankers would stretch **1185 miles from London to Rome**

Saving
£568,890
Not including effluent treatment savings

Water Savings of Over 95 Billion Litres / 25 Billion US Gallons per Year

AESSEAL® has sold thousands of water management systems in combination with a double mechanical seal. The systems are maintenance friendly, requiring no external compressed air or gas pressurisation.

They are also largely self-regulating, self-operating, and do not require any manual intervention for refilling. The total annual operating cost of a CDSA™ seal and SW2™ water management system would give a typical return on investment of around 200 days. Typical water consumption of between 6-18 litres per minute (1.59-4.76 US gallons per minute) per seal has been the previously accepted norm. Taking a more conservative estimate of 12 litres per minute (3.17 US gallons per minute) water consumption to all pumps run in this manner means that a pump operating continuously for 24 hours uses 6,307,200 litres per year (1.7 million US gallons per year). By retrofitting a water management system (which uses only 32 litres / 8.45 US gallons per year) to each of these applications, 6,307,168 litres / 1,666,178 US gallons per year for every water management system are saved.

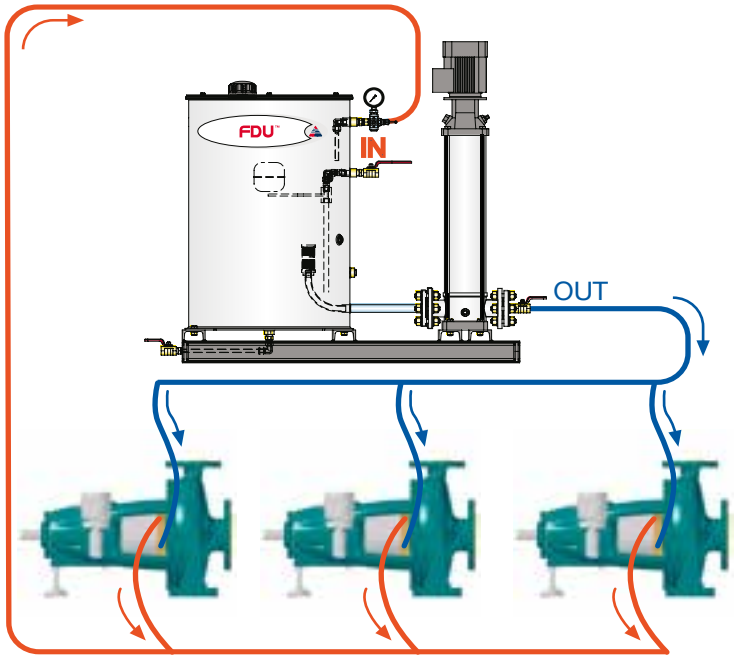
With in excess of 15,000 systems running globally, AESSEAL® water management systems contribute to water savings of over 95 billion litres / 25 billion US gallons per year!

Saving water, energy and £47,000 a year

A UK based food and beverage company was operating 16 pumps, with a quench to drain seal support system. This was costing the company over £47,000 per year in energy and effluent disposal, without taking into account the environmental cost of the wasted water.

Energy costs alone were over £27,000 a year just for heating the water that was then being sent to drain. AESSEAL® installed a Fluid Distribution Unit (FDU™), and the T01FU™ seal (which is specifically designed for use with Fristam pumps). The FDU™ unit, which is capable of supporting the seals on multiple pumps, operates in a closed loop API Plan 54 environment, offering significant water savings over a quench to drain system.

Since installation, the FDU™ system has decreased energy costs by over 900% and decreased effluent disposal by over 1,500%. This has contributed to a £47,000 per year cost saving, and a considerable reduction in water wastage.



FDU™ in Plan 54 arrangement — showing how the FDU™ can supply multiple seals in a closed loop operation.

Saving Over 192,000 US Gallons of Water per Day and $2.6m per Year

For a mechanical seal to perform reliably it is important that the seal faces are kept cool and clean. While for some applications it is possible to use the process fluid, in many applications this is simply not possible.

When this is the case, one approach is to use a single pass flow-through configuration from a water feed. However, this solution can have some drawbacks:

- The system usually depends on a separate pumping system that can cause seal failure if, for some reason, power is lost to that pump. Even when the source is a main plant water supply, variation in that supply (pressure or flow) can cause seal failure.
- Damage to the inboard seal faces can result in contamination. of the process fluid from the barrier fluid leakage.
- If used on multiple seal installations, failure on one system can have an effect on all the other installations unless proper precautions are taken to isolate the failed seal.
- Systems can be costly compared to other configurations, depending on the number and type of redundant and safeguard systems used.

Single pass flow-through systems are commonly found in the food & beverage industry: AESSEAL® found that the 726 pumps on one site were consuming more than 1 million US gallons of water per day. It was found that 405 of the flow control devices were set at maximum flow, leaving the potential for uncontrolled internal leakage resulting in contamination of the process fluid. Upon further investigation, it was found that 79 of the seals were leaking a minimum of 8,000 US gallons per hour (192,000 US gallons per day).

AESSEAL® proposed replacing the single pass configurations with an SW2™ Water Management System. The water management system is a closed-loop solution that connects directly to the plant water supply. The pressure of the barrier fluid can be set using a regulator for each seal so that it is 1bar / 15psi above the pump stuffing box pressure. This pressure differential ensures that the process fluid does not contaminate the barrier fluid and that the seal faces are provided with a clean fluid film. The barrier fluid is circulated from the seal to the tank by a thermosyphon effect. These systems eliminate the excessive water usage while improving the seal reliability (through optimization of the seal environment).

The customer placed an order for 450 SW2™ water management systems, which will yield an annual saving of over $2.6 million. The investment in the upgrade was recovered in just 4.5 months.

SW2™ Water Management Systems

Industry:
Food & Beverage

Water Savings:
> 192,000 US Gallons per Day

Savings:
> $2.6 Million per Year

ROI:
4.5 Months

Reference Nº:
CH01814

Reducing Energy Usage in the Pulp & Paper Industry
Cost $8,000; Savings $56,000 and Counting

A pulp and paper manufacturer was using gland packing on their 4th effect evaporator. To reduce energy usage, conserve water and increase reliability, they turned to AESSEAL®.

AESSEAL® upgraded the gland packing to a CDSA™ and SW Range water management system operating in an API Plan 54 arrangement. The CDSA™ is a dual mechanical seal specifically designed for difficult applications. The seal incorporates design features that enhance leak-free performance and trouble-free operation with self-aligning faces to ensure both the inboard and outboard faces remain square (90º), to the rotating shaft. The unique 'universal joint' concept means each face remains flat across a wide pressure range. A spring-loaded internal rotary centrifuges solids away from the seal faces, avoiding clogging from process fluids.

The seal and support system have been in place for over nine years and have helped:

- Reduce water usage by 24 million US gallons of water (with a saving of over $56,000).
- Increase pump reliability.

With a return on investment of less than two months, the solution specified by AESSEAL® has proved a sound decision.

CDSA™ With SW Range Water Management System

Industry:
Pulp & Paper

Application:
4th Effect Evaporator

MTBF Increase:
1000%
(and counting)

Savings:
24 Million US Gallons of Water

ROI:
<2 Months

Reference Nº:
CH00191

Experience the Exceptional in the Pulp & Paper Industry

We live in a society where “paperless” is often the default option for bank statements, utility bills and good office practice, yet the pulp & paper industry is still one of the biggest industries in the world.

The industry has seen great change driven by changing consumer behaviour and an awareness of the need to manage operations in a sustainable manner.

AESSEAL® offers a wide range of sealing solutions for the pulp & paper industry including solutions for stock process pumps, refiners, screens, agitators, knotters, deflakers, pulpers, fan pumps and turbo separators. AESSEAL® can make the pulping process more efficient, reducing the amount of energy required during the paper making stage by offering a unique, patented range of water management seal support systems that increase reliability at the pumping stage.

Did you know...?

Every tonne of paper that gets recycled saves 20 trees, three cubic yards of landfill space, 7000 gallons of water, and produces 73% less air pollution than making paper from new materials. It also saves enough energy to power the average home for six months.

Everyday Usage

Pulp & Paper is one of the largest industries so it should come as no surprise that paper is used in almost every aspect of our daily life.

From reading the newspaper to keep abreast of global news to filling our cupboards with the weekly food shop, it is estimated that each person consumes around 60kg of paper per year. This is influencing an increase in the production of paper and paperboard which currently stands at approximately 390 million tonnes per year, and it is estimated to increase to 490 million tonnes by the end of 2020.

Kitchen Roll

Envelopes

Tissues

Toilet Paper

Magazines

Stationery

Nappies

Clothing Products

Books

Greeting Cards

Napkins

Bags

Games

Storage Boxes

Flyers

Medical Products

Catalogues

Newspapers

Brochures

Baking Paper

Packaging

The Pulping Process

Pulping is the process that has been developed to separate cellulose fibers in wood from the lignin that binds these fibers together.

There are two main approaches to pulping: mechanical and chemical, each with their advantages and disadvantages.

Mechanical pulping

Stone groundwood (SGW) pulping is the process that uses stones to grind against small logs. This process produces a high yield but the resulting pulp is often too weak to be used by itself and has to be mixed with other more expensively produced chemical fibers.

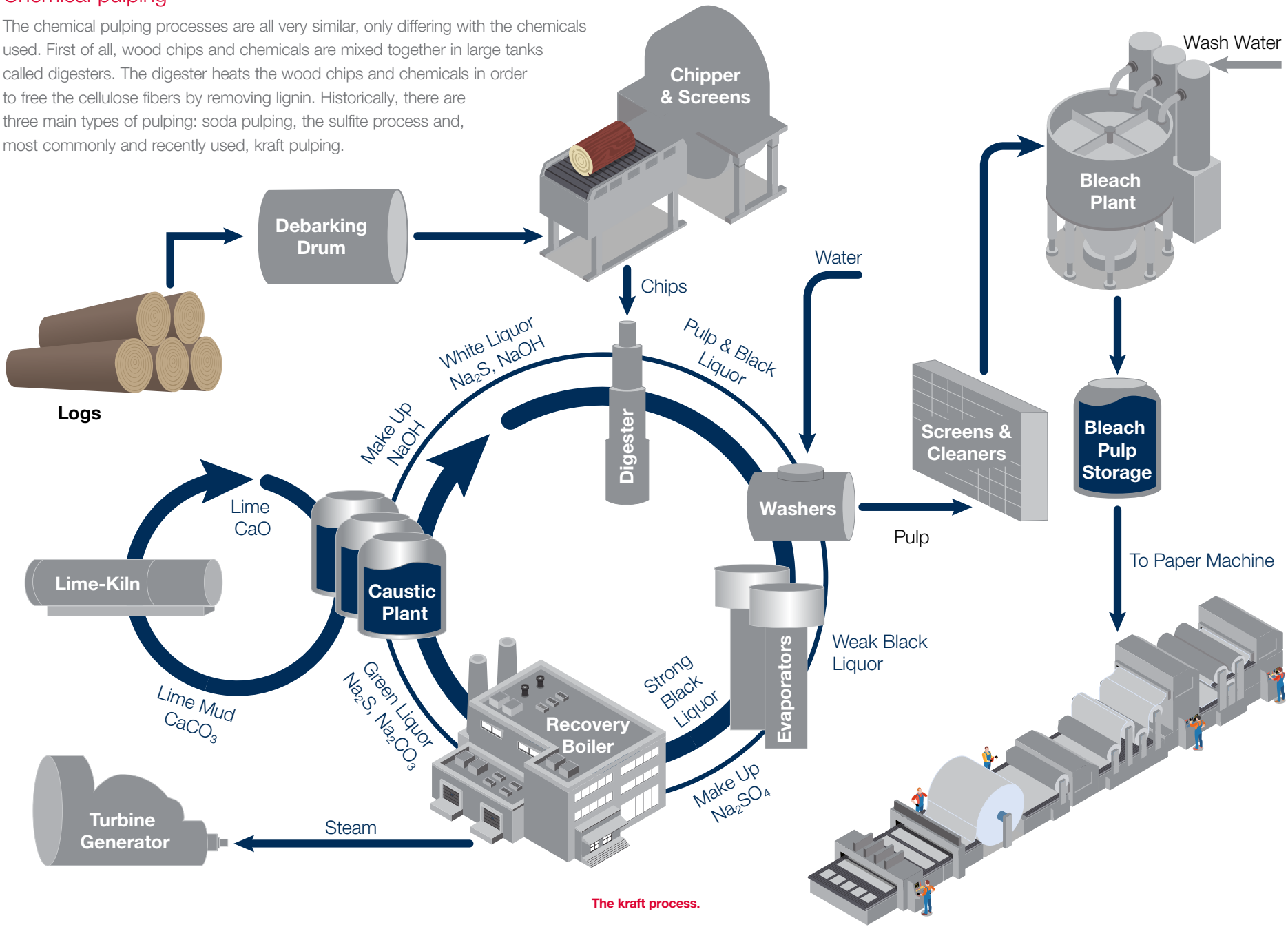
Refiner mechanical pulping (RMP) is a process that can begin with logs or wood feedstock like sawdust and wood scraps. It uses two grooved discs to grind the wood feedstock and this results in high yield but with fibers that have greater strength in comparison to SGW.

The most commonly used mechanical process is thermomechanical pulping (TMP), which involves steaming wood chips in order to soften them: these wood chips are ground between two grooved discs. The quality of this pulp is higher, although the energy used to create steam makes this method expensive.

Chemi-thermomechanical pulping (CTMP) is a high energy process but produces a high quality end product that is flexible and has long, high fiber content that can give higher pulp brightness. The process involves applying chemicals to the wood chips, which results in less destructive separation of fibers.

Chemical pulping

The chemical pulping processes are all very similar, only differing with the chemicals used. First of all, wood chips and chemicals are mixed together in large tanks called digesters. The digester heats the wood chips and chemicals in order to free the cellulose fibers by removing lignin. Historically, there are three main types of pulping: soda pulping, the sulfite process and, most commonly and recently used, kraft pulping.



The kraft process.

Recycling and Environmental Impact

Recycling

The pulp & paper industry makes use of post-consumer recycled paper by using it as a raw material. The recycled paper has to pass through a chemical procedure to remove any ink or other unwanted elements from the fibers; this procedure is called deinking.

The most common deinking method is known as froth flotation and it involves hot water, usually at a temperature between 45-55°C. Air is blown into the pulp causing the ink to separate and float to the top and create a layer of froth. This process is repeated several times until the desired effect is reached. The resulting products from this type of pulping are usually toilet paper and tissues.

Addressing environmental impacts

The pulp & paper industry is one of the largest consumers of water and the 4th largest consumer of energy. The industry uses 40% of the world's cut timber and is responsible for destroying over 30 million acres of forest each year.

The industry has acknowledged that the process of making paper can have a significant environmental impact, they consequently:

- Have proactive sustainability policies aimed at reducing the amount of water and energy used.
- Ensure timber is sourced from sustainable sources.

The pulp & paper industry has begun to address some of the environmental issues by sourcing their raw materials from sustainable forests, such as FSC (Forest Stewardship Council) who have procedures in place to ensure the trees are replaced and the forest is not lost.

FSC®

The water pollution caused by the bleaching element of the pulping process has also begun to be addressed by changing the chemicals used. Most notably, some mills aim to produce totally chlorine free paper, which reduces water pollution and creates a cleaner environment.

Sustainability and Energy Savings of $1,500,000

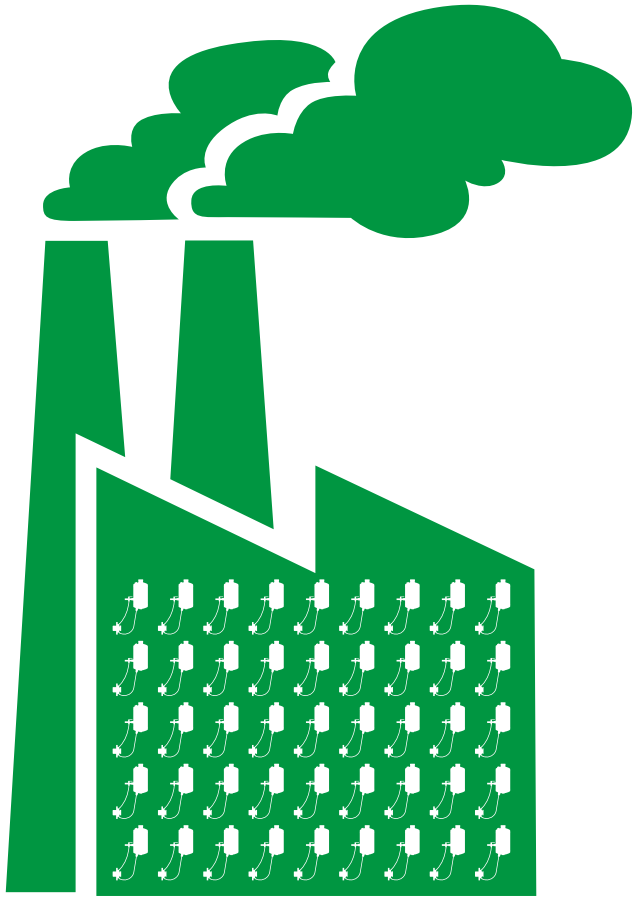
A leading North American producer of pulp and paper recognizes the importance of operating their business in a sustainable way.

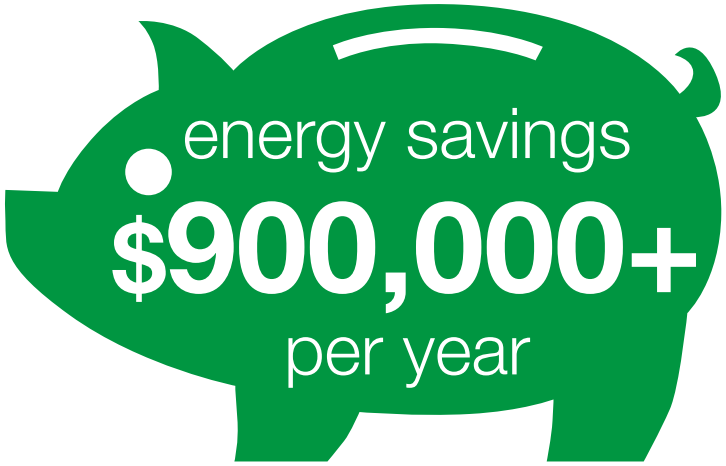
This involves not only responsibly sourcing wood from sustainably managed forests and generating renewable energy to run their facilities, but also improving safety performance and operating their plant efficiently. When presented with an opportunity to reduce plant energy and water usage while improving pump reliability, the company were keen to hear more. AESSEAL® started working with the company after it was asked to review a number of 'bad actor' pumps at one of their sites that used a competitor's seal and seal support system. Success with sealing these pumps has led to a collaborative relationship developing between supplier and customer.

As part of this collaboration, AESSEAL® undertook a seal energy audit where the energy used by the seal and seal support system of each pump is measured. The audit recommended upgrading a number of pumps with the latest technology dual mechanical seal and water management systems. This was to have the benefit of reducing water and energy usage, while improving pump reliability. AESSEAL® installed the first upgrades on three chemical mixers and, with the upgrades installed, their reliability was improved significantly. Three Effect pumps were also upgraded and these gave energy savings of $30,000 per year.

The following year, 14 pumps were upgraded giving additional energy savings of over $400,000 per year. A further 25 pump sealing system upgrades were made in the next year, which gave a further $455,000 in energy savings and almost $100,000 per year in maintenance cost reduction. By eliminating the need to reheat and evaporate injected water, the company is saving a total of over $900,000 in energy costs per year. In addition, improved reliability has reduced maintenance expenditure by $130,000 per year.

Since AESSEAL® started working with the company the latest technology dual mechanical seals and seal support systems have been installed on numerous plant locations in the USA. One facility has over 70 dual seal and support systems in operation. Over this period the company has saved more than $880,000 on maintenance and almost $1,500,000 in energy costs, through upgrading pumps that were sealed with packing or single mechanical seals to dual mechanical seals and systems.





Upgrading Unreliable Seals Increases Mean Time Between Failures (MTBF) From 2-3 Months to Three Years

A leading manufacturer for the pulp & paper industry increases plant reliability and reduces maintenance costs.

A number of paper machine condensate pumps around the facility were experiencing premature mechanical seal failure as a result of lack of constant lubrication caused by loss of pressure in the system. The seals were failing every two to three months.

AESSEAL® installed a CDFI™ double flow induction mechanical seal with a SWC™ 25cc seal support system. The seal includes an internal barrier fluid circulation device to ensure that the barrier fluid flows around the seal surfaces. In addition, the seal support system ensures that the barrier fluid is maintained at the seal faces even during shutdown and maintenance outages. The new seals have improved pump performance increasing the MTBF from 2-3 months to three years.

CDFI™ and SWC™ 25cc Seal Support System

Industry:
Pulp & Paper

Application:
Paper Machine Condensate Pump

MTBF Increase:
>1000%

Reference Nº:
CH00250

Improved Reliability and Reduced Water Usage

A pulp and paper manufacturer in France was using gland packing to seal the side entry agitator on a stock pulp mixer. The gland packing had a MTBF (Mean Time Between Failures) of just two months and was using 2.4 million litres of water per year. The company turned to AESSEAL® for assistance.

AESSEAL® upgraded the gland packing to a CDM™ seal with a SW2™ water management system. The CDM™ seal was chosen as it allows up to 1.5mm of radial movement. The system was installed in August 2012 and ran until a planned refurbishment in August 2017.

The seal and seal support system was in place for five years and improved the MTBF from two months to five years. In addition, 12 million litres of water were saved in this period.

CDM™ and SW2™ Water Management System

Industry:
Pulp & Paper

Application:
Stock Pulp Mixer

MTBF Increase:
2900%

Savings:
12 Million Litres of Water

Reference N°:
CH01570

Experience the Exceptional in the Food & Beverage Industry

AESSEAL® understands that its customers in the food & beverage industry are crucial to the world's food supply.

That is why it has a wide variety of world-class products to suit the wide range of pump makes and models used in the food & beverage industry. From sealing a Puma or Fristam pump in a dairy plant to sealing a four-storey fermenter in a bioproducts plant, it has the product offering to meet industry requirements.

AESSEAL® believes in cleanliness and controlling every step of the supply chain. The manufacturing facilities in which its products are produced are world-class; just what you would expect from a supplier to the food & beverage industry.

Did you know…?

Chocolate was once used as currency. As early as 250 AD, ancient civilizations of Mexico and South America used the cocoa bean as a system of money.

Food and Beverage Production

Food and beverage production is one of the most important industrial processes for our society.

It is extremely complex and varied, with very few industries having such a diverse range of processes. There is often a range of processes involved to produce a final product. Food processing is the transformation of raw ingredients, by physical or chemical means into food, or of food into other forms. Food processing combines raw food ingredients to produce marketable products that can be easily prepared and served by the consumer.

Food processing

Primary food processing involves taking the raw produce from agricultural processes and processing it to become edible. Examples of such processes may be drying, milling, shelling, freezing, smoking and pasteurising.

Secondary food processing is the process by which ingredients that are produced through primary processes are used as ingredients to produce ready to consume products such as bread, sausages, and beer.

Beverage production

Beverage production may be defined as the processing of the raw, semi-prepared or prepared beverage product, so that it is in a ready-to-drink state before being served to the customer. For example, a raw beverage product such as tea would need to be fully processed before being served, a semi-prepared product such as a cordial would require only partial preparation, and a bottled fruit juice or bottle of wine may be termed a fully-prepared beverage product.








Regulation and Safety

The food & beverage industry requires that mechanical seals use materials conforming to the appropriate food and beverage safety standards that maximize reliability.

Food safety

Many areas of the world apply strict regulations to food safety. These regulations cover all aspects of the supply chain from production, processing, transportation and distribution to the supply of food. While the detail of the legislation may vary in different countries, in general the regulations seek to ensure that equipment is kept clean, efforts are made to eliminate the opportunity for bacteria growth, and the materials that come into contact with food do not contaminate it in any way.

EU, FSA and FDA compliant components

In the European Community, EU Directive 1935/2004 is valid for suppliers or users of items or ingredients intended for food contact, or items where it is likely that they can or will come into contact with food. The Directive, whilst very clear in some aspects, appears non-specific in others and is therefore open to interpretation. The Food Standards Agency (FSA) guidelines suggest that in such circumstances 'best practice' is applied and should be supported by robust documentation. The US Food and Drug Administration (FDA) Food Safety Modernization Act (2011) means that food producers are required to evaluate the hazards in their operations and implement and monitor effective measures to prevent contamination.

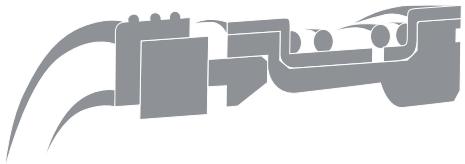
Why trust AESSEAL®? The materials it uses are traceable in accordance with EC1935/2004 article 17 and its stock control systems are third-party audited to ISO9001. It supplies Food and Drug Administration (FDA) and EU Directive 1935/2004 compliant product-wetted materials as standard so its customers can be assured that their site complies. More importantly it can trace the components from which the seal was built back through the supply chain. Its seals are manufactured in accordance with Good Manufacturing Practice (GMP) which assures compliance with EC2023/2006.

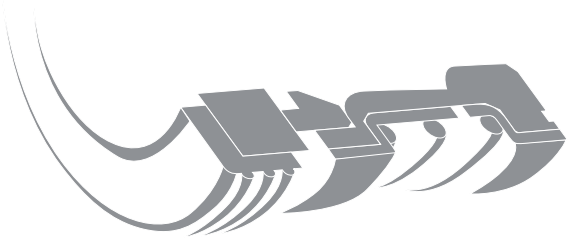
Product Design

The AESSEAL® F- range mechanical seal uses materials that are suitable for contact with food.

AESSEAL® controls the design and procurement of virtually every component in its F- product range to ensure that they are made to the world-class standards its customers expect. Demonstrating its commitment to delivering exceptional products, AESSEAL® embarked on one of its most ambitious product development projects in 2015. Involving a total of almost 40,000 man hours and more than £500,000 of capital investment, this delivered a completely reengineered portfolio of component seals.

Assembled to order, the seals include compatible industry standard ranges and a number of new plug-in style designs that offer significant benefits over traditional component seals. The built-to-order approach allows unrivalled product flexibility with over 44,000 product variants being configurable from just a fifth of the stocked components. Complete control of the supply chain also allows AESSEAL® to provide food safe products backed up with appropriate certifications. In total, 97 seal types in 55 ranges were completely redesigned with five new patents protecting the most popular products.





Reducing Energy Usage and Improving Reliability

Suiker Unie were using packing to seal juice circulation pumps at their Dinteloord sugar refinery. Typically, after three 120-day ‘campaigns’, the packing on these pumps required replacement and, as a result of wear caused by the packing, the shaft sleeves also needed to be replaced.

In addition, water used to maximize the life of the packing leaked into the product, and needed to be removed by evaporation. For Netherlands-based sugar producer Suiker Unie, saving energy is a key element of its sustainability program and they have a goal to cut energy consumption by 50% by 2030 relative to 2005. Removing the need to evaporate off seal water from the product has the potential to save energy.

In order to address the leakage and shaft wear issues AESSEAL® recommended replacing the packing with a CDSA™ dual seal along with a SW2™ seal support system on 12 pumps, coupled with a single FDU™ installation. Changing from packing to a dual mechanical seal eliminated shaft wear and after six years of operation (approximately seven campaigns) the system is operating without failure. The change from packing to double seals with support system has resulted in Suiker Unie receiving tax benefits from the government for saving both water and energy. In order to qualify for this tax benefit, the company must achieve an energy saving of between 0.6 and 1.5Nm^3 natural gas equivalent per invested Euro.

Water and energy savings

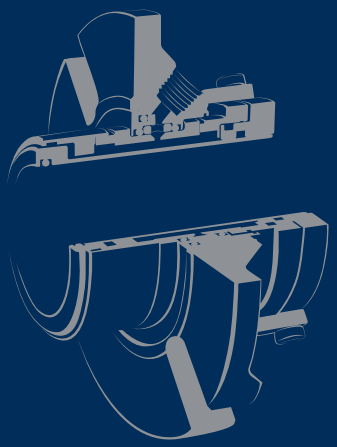
With packing water usage measured to be 48 litres per hour per pump, giving water usage per campaign to be:

12 pumps x 48 litres x 24 hours x 120 days campaign = 1,658m^3.

1,658m^3 is 1,658 tonne return flow. To evaporate 1 tonne of water requires approximately 100m^3 of gas. Total gas usage to evaporate the injected seal water is, therefore, 165,888m^3.

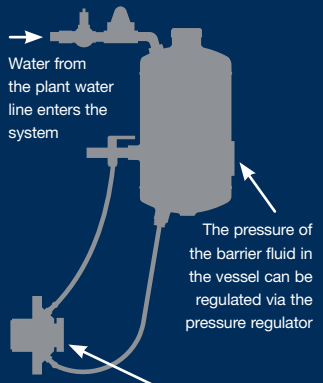
Changing to dual seals with support systems has resulted in no significant leakage of water and has saved energy, as there is now no requirement to evaporate off seal water. As a result of the excellent performance, the plant has subsequently installed additional seals and support systems, replacing packing on 43 pumps. With the upgrade applied to 43 pumps, more than 5,944m^3 of water will be saved each year, reducing gas usage by 594,432m^3 / year. This is equivalent to approximately £181,000 / year saving*.

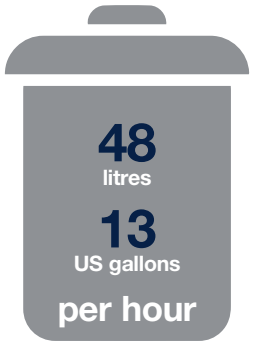
(* Based on a cost of gas of £0.0274 / kWH)



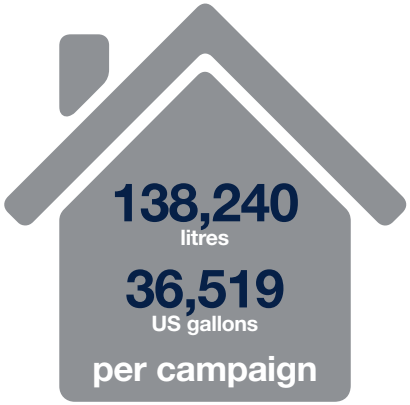
CDSA™ Dual Seal

SW2™ Water Management System



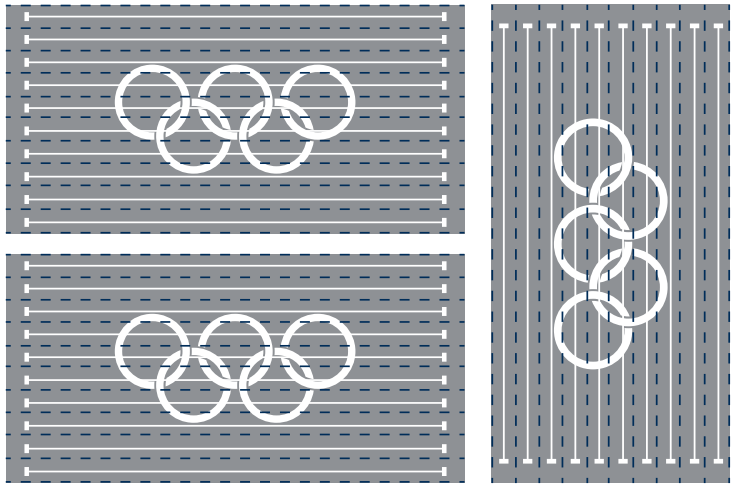


Enough to fill 2,880 dustbins per campaign, per pump



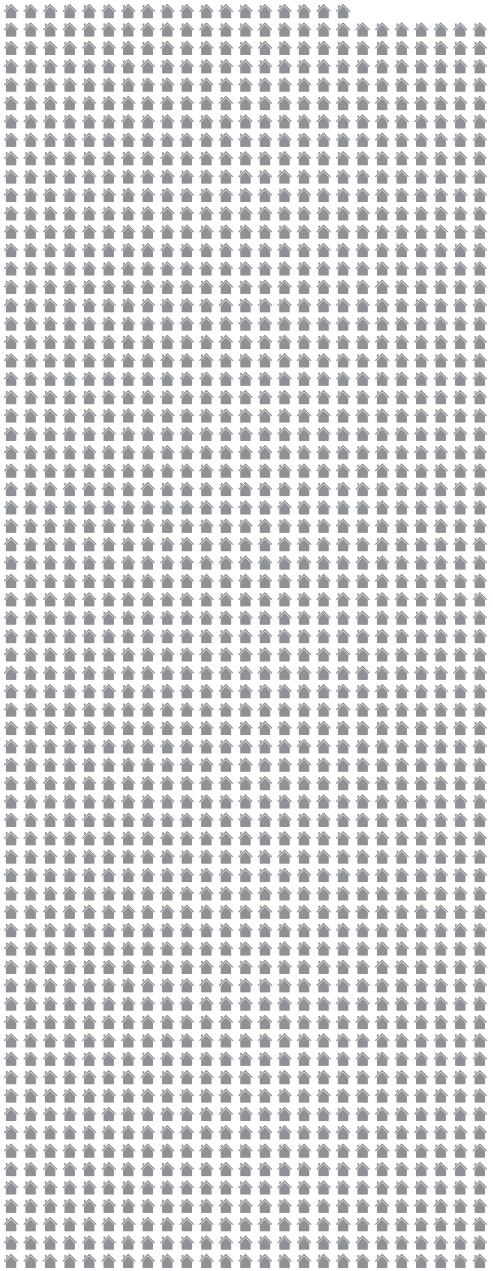
Equivalent to 1 UK household water usage in 1 year, per pump

Water Savings



Upgrading 43 pumps reduces water by 5,944m^3
Equivalent to filling 3 Olympic swimming pools per campaign

Energy Savings



Upgrading 43 pumps saves 594,432m^3 of gas per year
Equivalent to 1,718 UK homes energy usage per year

Eliminating a $225,000 Ongoing Maintenance Bill

A leading food processor was experiencing problems sealing two of their NASH vacuum pumps. Over a two year period, the pumps had cost over $75,000 in maintenance, mainly related to bearing failure due to the leakage from the packed gland.

A major challenge for AESSEAL® was getting a mechanical seal and LabTecta® bearing protector to fit, without modifying the pumps. After utilizing previous application experience, CURC™ single mechanical seals were installed. The CURC™s were custom made to ensure that no modifications were required to the pump stuffing box, as the seals were designed to slide through the bearing housing and to be clamped onto the shaft with a C ring clamp.

These seals have been running for over 6 years with zero failures. The upgrade has not only significantly reduced the predicted 6 year maintenance bill of $225,000, but the mechanical seal upgrade has created a greater vacuum resulting in fewer pumps running, and reduced energy bills.

Custom Designed CURC™ Seal With LabTecta® Bearing Protector

Industry:
Food & Beverage

Application:
NASH Vacuum Pumps

ROI:
6.1 Months

Savings:
$225,000

Reference N°:
CH01196

Food & Beverage Customer Reduces Product Leakage, Saving Over £40,000 per Packaging Line

A Polish manufacturer was experiencing leakage from the lip seals on the rotary valves in the transport lines in the product packaging line.

The lip seals started leaking product almost immediately after being fitted and required replacement every four weeks. In addition to product leakage, the seals also damaged the valve housing and shaft sleeve. The time to replace the lip seals was approximately 33 hours and cost more than £68,000 in parts every year, per line. A solution needed to be found as product leakage was unacceptable on this site.

Asked by the manufacturer to suggest a solution, AESSEAL® recommended replacing the lip seals with MagTecta™ bearing protectors. The MagTecta™ bearing protector uses mechanical seal technology to prevent leakage from the housing and its non-contacting design ensures no wear on the shaft or housing. Upgrading the lip seals to MagTecta™ improved the Mean Time Between Failures (MTBF) to three months: however by also upgrading the bearings and the housing sleeves this has further improved to six months.

Following the successful upgrade to the rotary valves at the Polish plant, the customer has also rolled the solution out across their other plants.

Line before upgrade — product leakage clearly seen.

Housing — showing wear.

Line after upgrade — no product leakage.

MagTecta™

Industry:
Food & Beverage

Application:
Rotary Valves

MTBF Increase:
600%

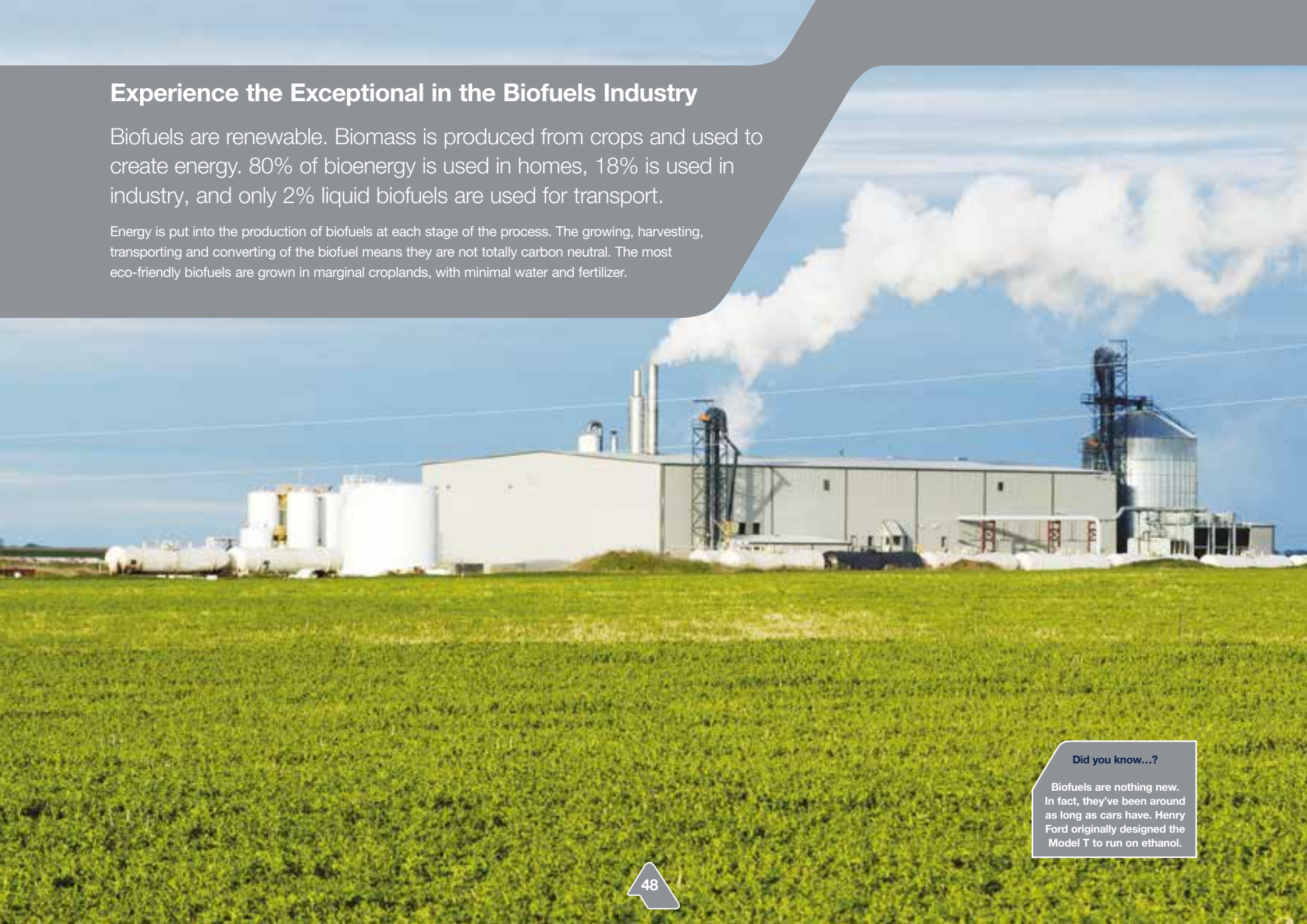
Savings:
£40,000+ per line

Reference N°:
CH01485

Experience the Exceptional in the Biofuels Industry

Biofuels are renewable. Biomass is produced from crops and used to create energy. 80% of bioenergy is used in homes, 18% is used in industry, and only 2% liquid biofuels are used for transport.

Energy is put into the production of biofuels at each stage of the process. The growing, harvesting, transporting and converting of the biofuel means they are not totally carbon neutral. The most eco-friendly biofuels are grown in marginal croplands, with minimal water and fertilizer.



Did you know…?

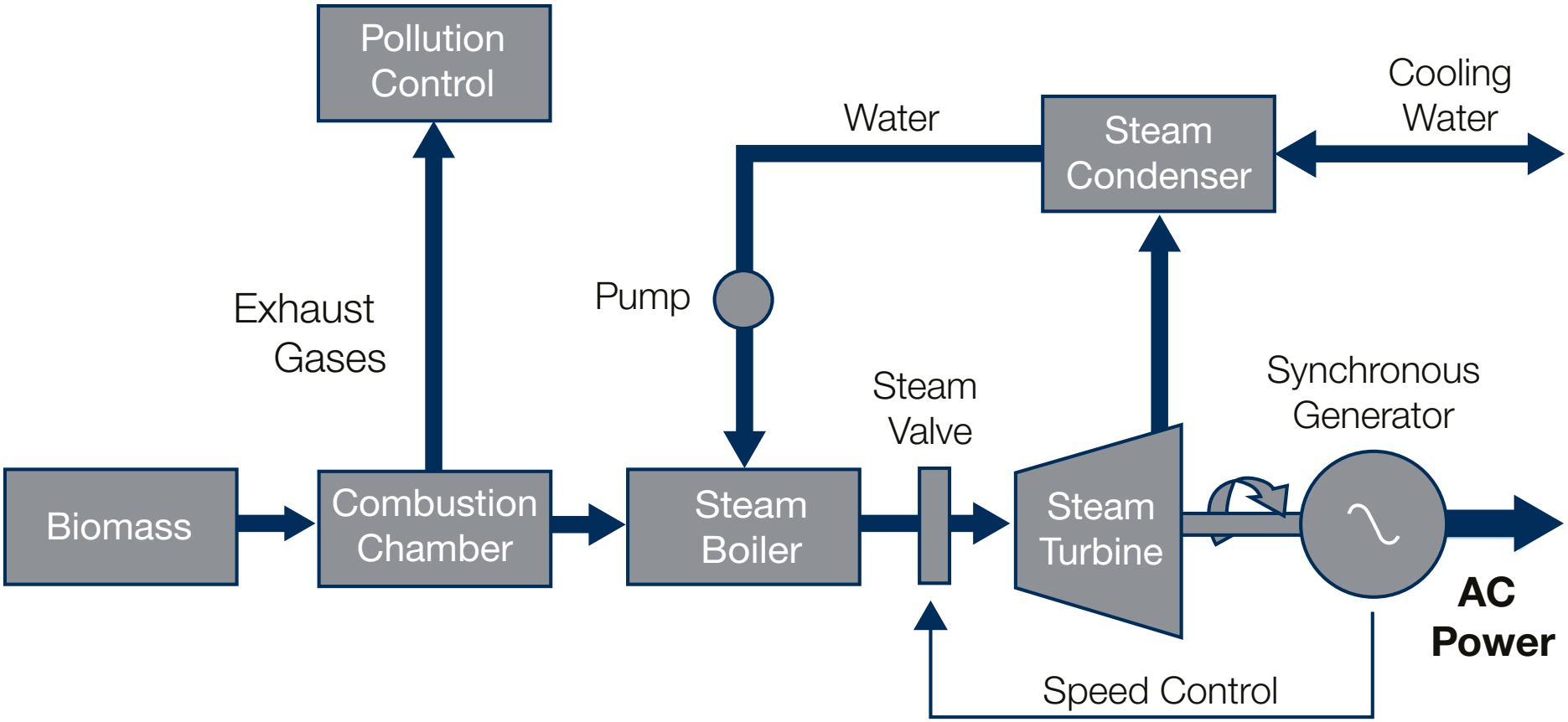
Biofuels are nothing new. In fact, they've been around as long as cars have. Henry Ford originally designed the Model T to run on ethanol.

Biomass Electricity Generation

The efficiency of electricity generated plant fuelled by biomass is typically only around 35%. This changes with each type of biofuel.

A biomass power plant is similar to a traditional power plant. The fuel is burnt and a steam turbine turns the heat energy into kinetic energy, then into electrical energy, which is directed to the National Grid.

Advantages:	Disadvantages:
Renewable	High cost of production
Less pollution	Puts pressure on food production
Less reliance on fossil fuels	Biodiversity of areas are decreased



Electricity generation powered by biomass.

Ethanol and Biodiesel

Brazil is the largest producer of ethanol, derived from sugar cane.

In 1978 they made the first production car that can run on 85% ethanol. By pioneering ethanol as a fuel they became less dependant on oil. Ethanol is blended with gasoline to create transportation fuel. Most cars can run off 5-10% ethanol.

The energy yield of ethanol is very low. For corn ethanol it is around 1.5:1 and sugar cane ethanol runs at about 8:1 efficiency.

Biodiesel is made through a chemical process called transesterification.

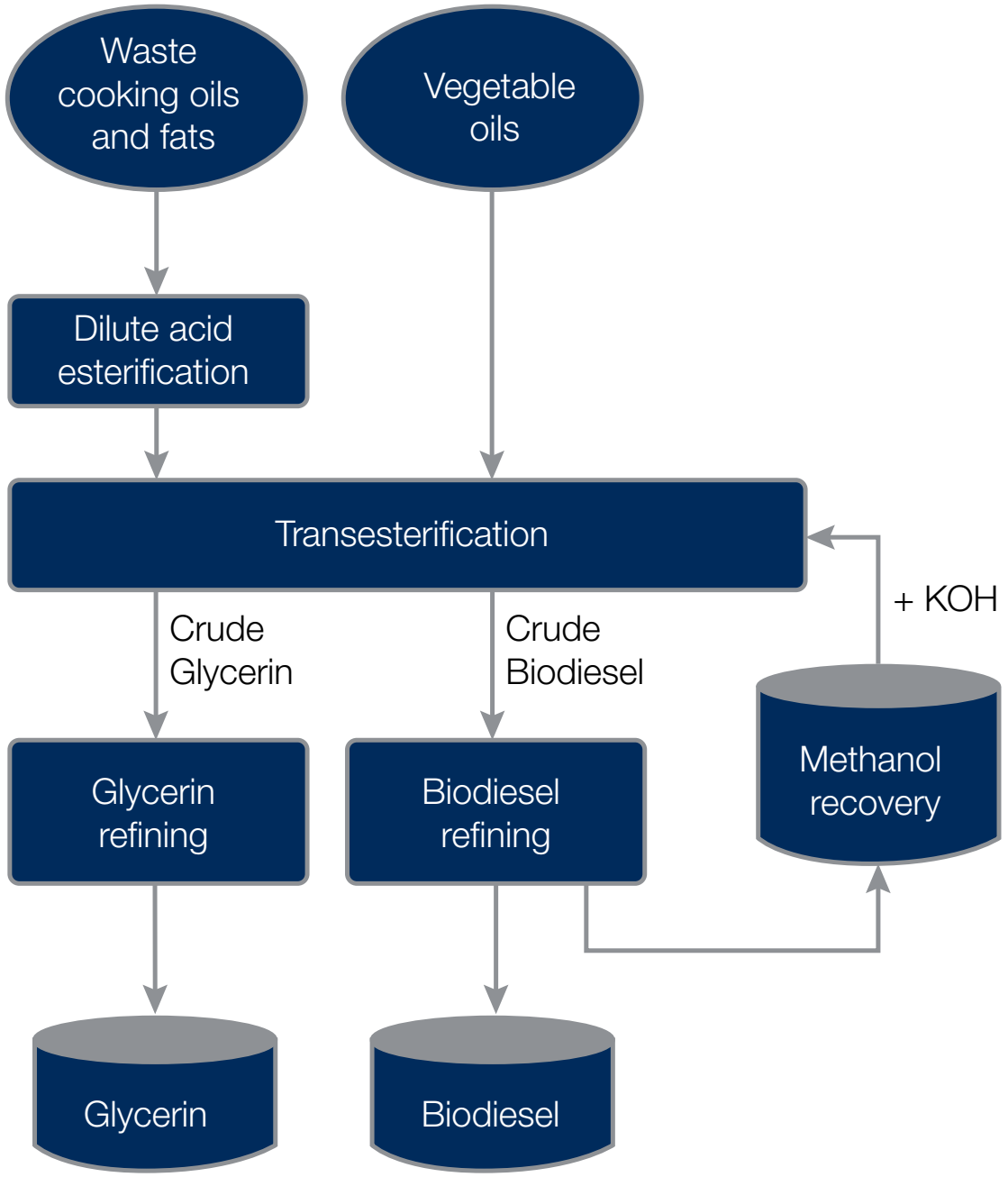
The process creates two products:

- Methyl esters (i.e. biodiesel).
- Glycerin (a by-product used in soaps and other products).

The production of biodiesel, is well known and there are three basic routes to production from fats and oils:

- Base catalysed transesterification with alcohol.
- Direct acid catalysed esterification with methanol.
- Conversion of oils to fatty acids, then to alkyl esters via acid catalysis.

Biodiesel is made by reacting vegetable / animal oils with alcohol to produce long-chain alkyl esters.



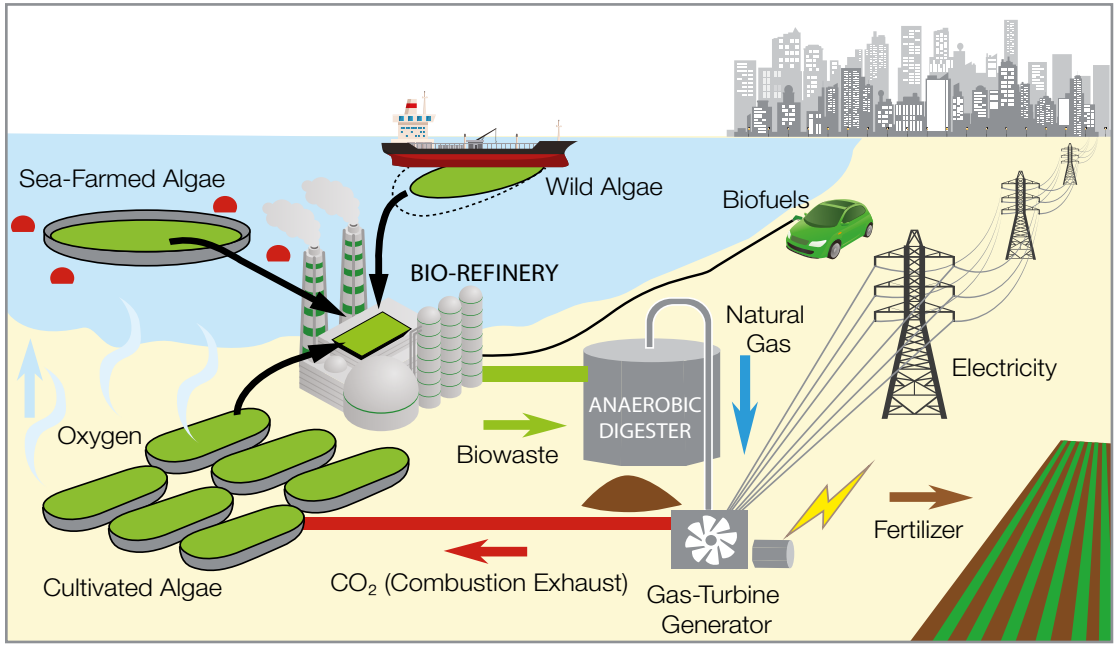
The biodiesel manufacturing process.

Algae

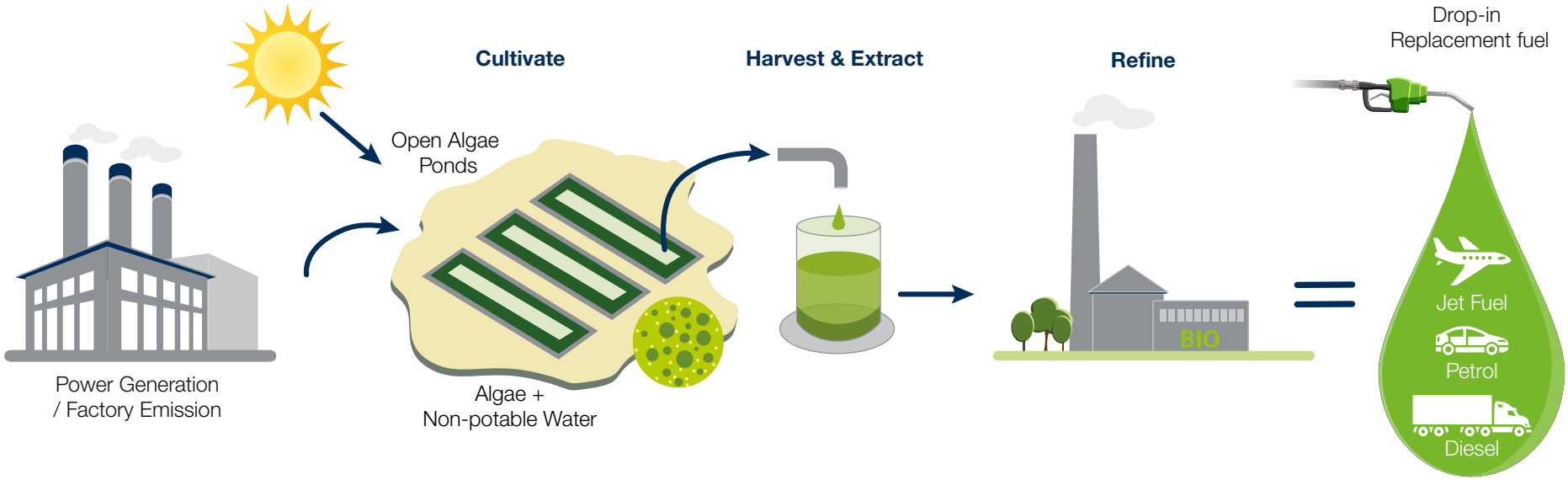
Algae consumes a lot of carbon dioxide while it grows.

Algae is fast growing; needing only water, sunlight and carbon dioxide. Algae is versatile; it can be grown in waste water, sea water, open ponds or bioreactors. Bioreactors are very expensive and in addition producers must find a cheap source of sterile carbon dioxide. Currently they are not suitable for commercial production, more funding and research is necessary to turn the potential of algae into a viable solution. There are 100,000 genetically diverse strains of algae; this is very useful for researchers who can use their unique properties to develop fuel.

In open ponds there are many problems related to contamination, viral infection, evaporation and low energy density of the oil. There are no negative effects of algae on global food supply and prices because it does not require land that could be used for cultivating food crops.



How energy can be created from sea-farmed algae (seaweed).



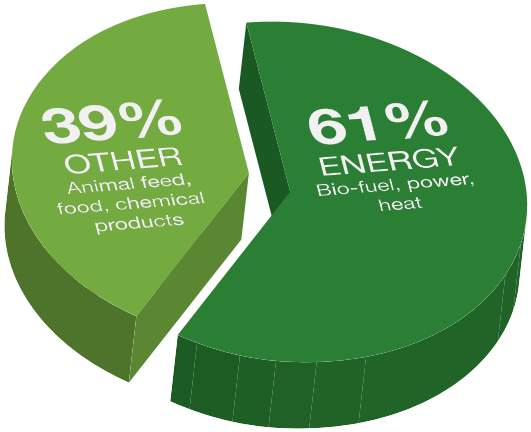
Algae biofuel production process.

Palm Oil

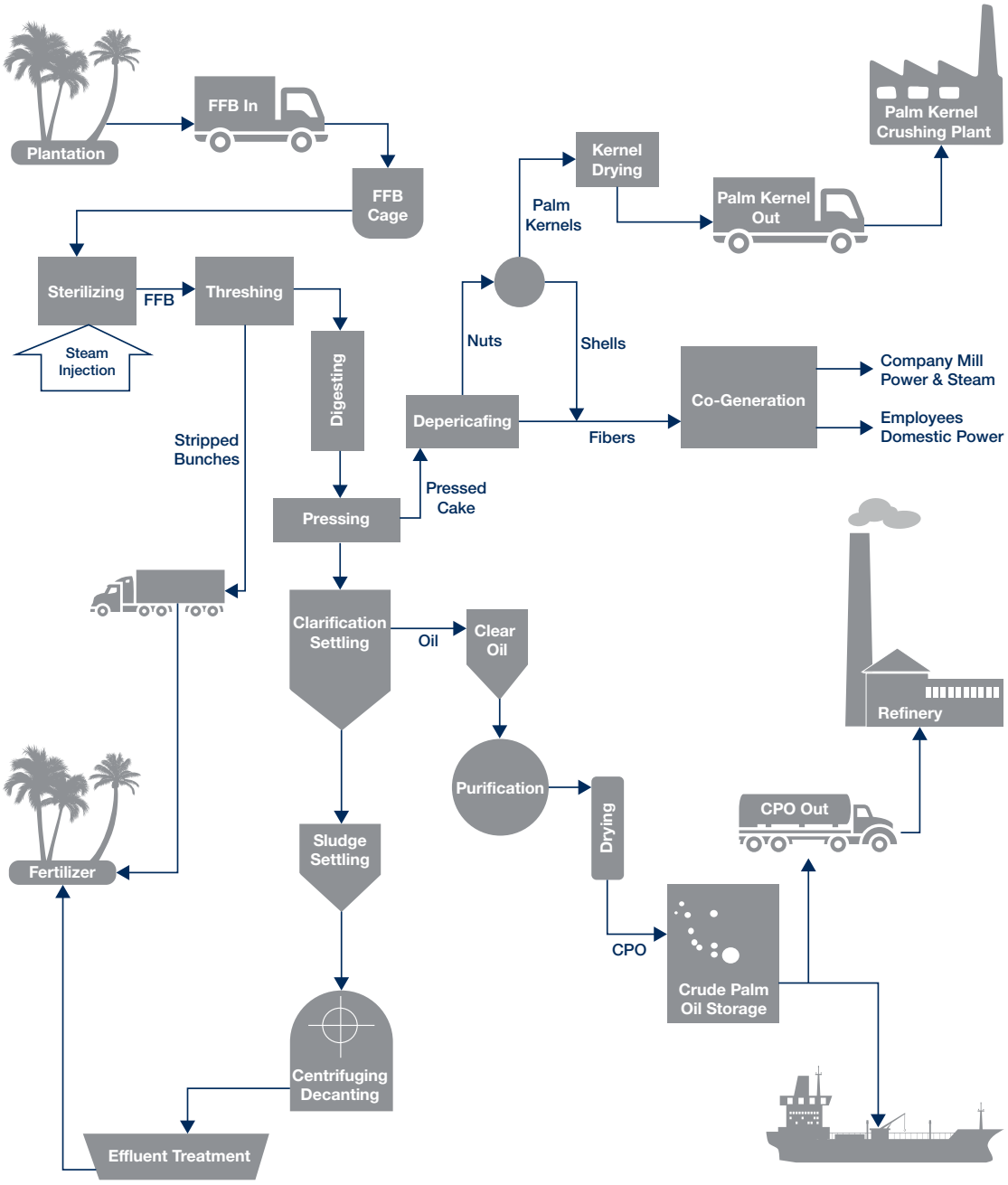
Malaysia and Indonesia are the biggest producers of palm oil in the world, with 57 million metric tonnes produced every year.

Low world market price makes palm oil perfect for use as a biofuel. This helps biodiesel compete with fossil fuel prices. Palm oil is used in biodiesel and in power stations to produce electricity. This demand is growing, meaning increased pressure on Malaysia and Indonesia. It has caused many environmental and social problems:

- Oil palm plantations currently cover more than 27 million hectares of the Earth's surface. Forests and human settlements have been destroyed and replaced by plantations containing virtually no biodiversity.
- As demand for palm oil has increased, the size of the plantations have grown, destroying small villages and orangutan's habitats.
- 1000 to 5000 orangutans are killed every year due to deforestation for palm oil plantations. They are now an endangered species.
- Indigenous people are brutally forced out of the forests they have lived in for generations. There have been 700 land conflicts due to palm oil plantations.



Palm oil consumption
7.7 million tonnes in the EU in 2017.



Crude palm oil milling process.

DMSF™ Upgrade Saves Over £460,000 a Year

One of the largest bioethanol production plants in Europe was having a failure every two months on a group of pumps in the distillation area of the plant, costing over £75,000 per outage.

The pumps are in a group of four and every time one fails the plant has to run at reduced capacity. The pumps are continuously running and the high temperature of the process fluid, which also includes up to 10% of solids, was causing the original seal arrangement to continually fail.

AESSEAL® installed a DMSF™ double seal with an SP3™ 25 litre system operating on an API Plan 53A. The DMSF™ incorporates a bi-directional pumping ring that delivers more barrier fluid to the seal faces than competing devices, ensuring that the seal faces stay as cool as possible. The SP3™ system was also supplied with finned tubing to further dissipate heat.

The cost to upgrade to the AESSEAL® solution was paid back within the first month and has saved the plant over £460,000 in the first year of operation. The upgrade is currently giving a 500% Mean Time Between Failures increase and ensures that the bioethanol plant is continually running at 100% capacity.

DMSF™ & SP3™ System

Industry:
Bioethanol

Application:
Stillage Duty

ROI:
1 month

MTBF Increase:
500%
(and counting)

Savings:
£464,035

Reference Nº:
CH01154

DMSF™ Improves Reliability

A bioethanol production plant in Poland was experiencing premature failure of a competitor's single seal with a steam flush on a high temperature glycerine transfer pump. The seal had a Mean Time Between Failures of three months.

AESSEAL® installed a DMSF™ double seal with an SP3™ seal support system. The SP3™ system was fitted with a cooling coil due to the high temperatures found in this application. The new solution operated without failure for the duration of the pump maintenance period (13 months) and the cost of the upgrade was recovered within 3.5 months of installation.

DMSF™ & SP3™ System

Industry:
Bioethanol

Application:
Glycerine Transfer Pump

ROI:
3.5 Months

MTBF Increase:
333%

Savings:
£9,000

Reference Nº:
CH01436

Experience the Exceptional in Other Industries

AESSEAL® products are in demand worldwide, and across all industry sectors.

Wherever AESSEAL® supplies, the story is the same: its sealing technology delivers increased reliability, demonstrated by increased Mean Time Between Failures. Today AESSEAL® works with an impressive portfolio of customers, in all industry sectors.

Portugal

"Late Friday is not a great time to identify a serious seal problem. But AESSEAL immediately got down to us and worked through the issues. They're now consulting for us on other plant equipment, improving MTBF. A real full-service partner!"

UK

"These steam turbine seals are so good you should be looking at rolling them out to refineries worldwide."

France

"We had a critical situation on a bitumen screw pump where four complex API type seals were required within three days. Philippe Olivier mobilized the entire design and production team at AESSEAL who delivered the solution within extreme deadlines. Magnifique!"

Italy

"Our previous supplier indicated that it was impossible to better two months' performance on an application. AESSEAL implemented a solution that has been running for over 15 months without problems and are now a key supplier for the entire plant."

Germany

"I was delighted by the way the engineer at AESSEAL reacted so fast to a broken bearing housing problem. It happened at 08:00hrs on a Sunday, and he measured up, opened up their workshop and we were running again on the Monday. AESSEAL jump immediately… Great service."

USA

"AESSEAL's ownership in the equipment is exceptional, as is its communication system. Our failure rate and reliability risks from seal failures have steadily declined. They provide maintenance and reliability with valuable information on the MTBF of the equipment."

Turkey

"The frequency of shaft packing damage was a problem in the lime progressive pump section. At AESSEAL they invested time to provide a technical solution in planning and on site installation. Before long they became our preferred seal supplier."

USA

"Every failure meant gear set replacement along with machining to repair bearing fits. Since we installed LabTecta we have doubled the previous lifespan and have savings to date of $96,000."

South Africa

"At our Glucose refinery we are not customers of AESSEAL but partners. With our input and AESSEAL's technical skills and reliable service, problem mechanical seals are a thing of the past."

South Africa

"AESSEAL discovered an innovative way of eliminating steam loss to atmosphere through a pump. The steam was re-circulated and used as a source of heat on other applications, which reduced heating costs by 70% and reduced carbon emissions.

Malaysia

"We believe AESSEAL is reliable, dependable and above all a company that conducts its business with a high level of integrity."

Australia

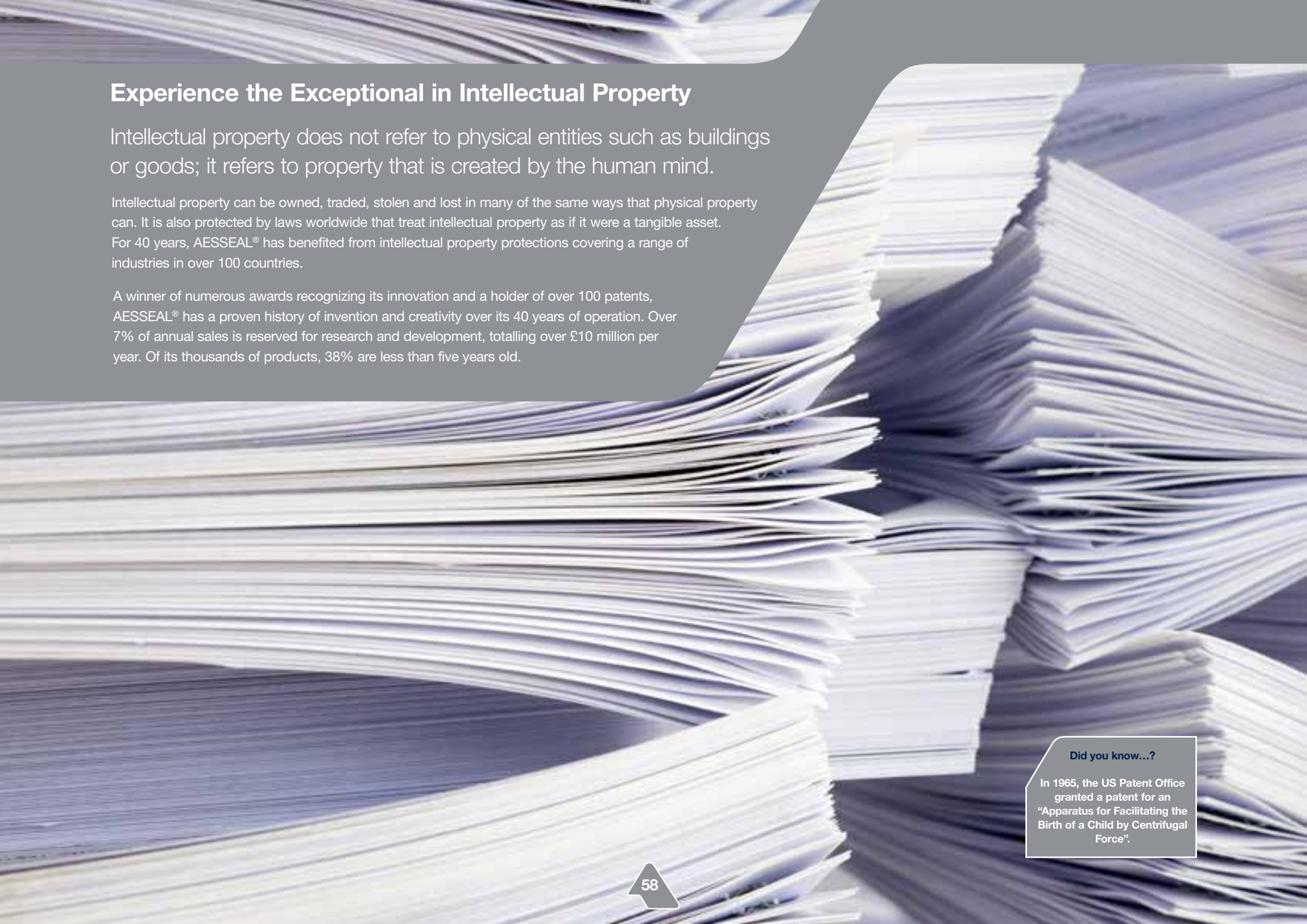
"A heavy-duty dual slurry seal is not easy to find over the Christmas period – but the AESSEAL guys gave up their public holiday to build one from scratch. They are always available to me, a great facility."

Experience the Exceptional in Intellectual Property

Intellectual property does not refer to physical entities such as buildings or goods; it refers to property that is created by the human mind.

Intellectual property can be owned, traded, stolen and lost in many of the same ways that physical property can. It is also protected by laws worldwide that treat intellectual property as if it were a tangible asset. For 40 years, AESSEAL® has benefited from intellectual property protections covering a range of industries in over 100 countries.

A winner of numerous awards recognizing its innovation and a holder of over 100 patents, AESSEAL® has a proven history of invention and creativity over its 40 years of operation. Over 7% of annual sales is reserved for research and development, totalling over £10 million per year. Of its thousands of products, 38% are less than five years old.



Did you know…?

In 1965, the US Patent Office granted a patent for an "Apparatus for Facilitating the Birth of a Child by Centrifugal Force".

What is a Patent?

The most common type of patent is known as a utility patent. A utility patent is an exclusive right which ensures the owners of the patent can prevent others from manufacturing, selling, importing and even using an invention for a limited period of time.

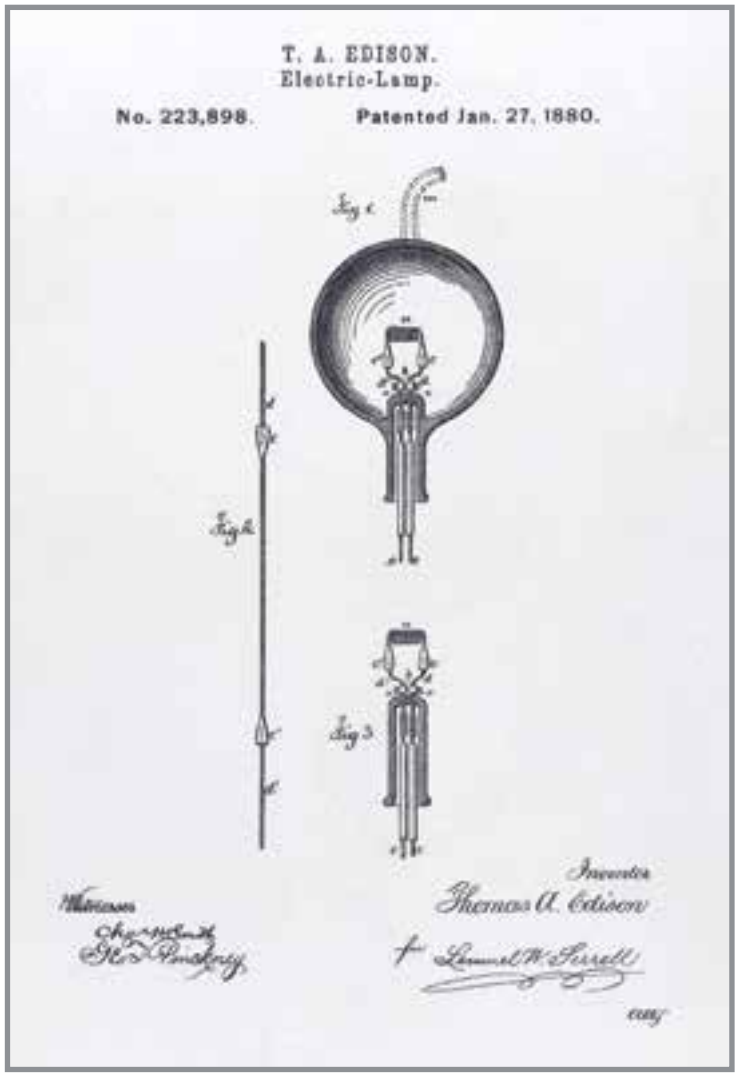
This patent is granted in exchange for the public filing of the details of the invention. The underlying intent of all patent law is to stimulate innovation for the public good. Patent systems generally do this in two ways: by encouraging the disclosure of the details of the invention and by encouraging the development of new inventions. Innovators may be incentivized towards the creation of new devices if they believe they can eventually benefit from invention.

The patent acts as a temporary monopoly on the ability to profit from an invention. The patent term allows the holder to either: monopolize the market for the invention, selling it at a high price, or allows the holder to licence to other parties the rights for its manufacture and sale; the patent holder instead is able to create an income stream for very little additional effort. The patent term also serves as a chance for the inventor to recover the investment made during the development of the invention.

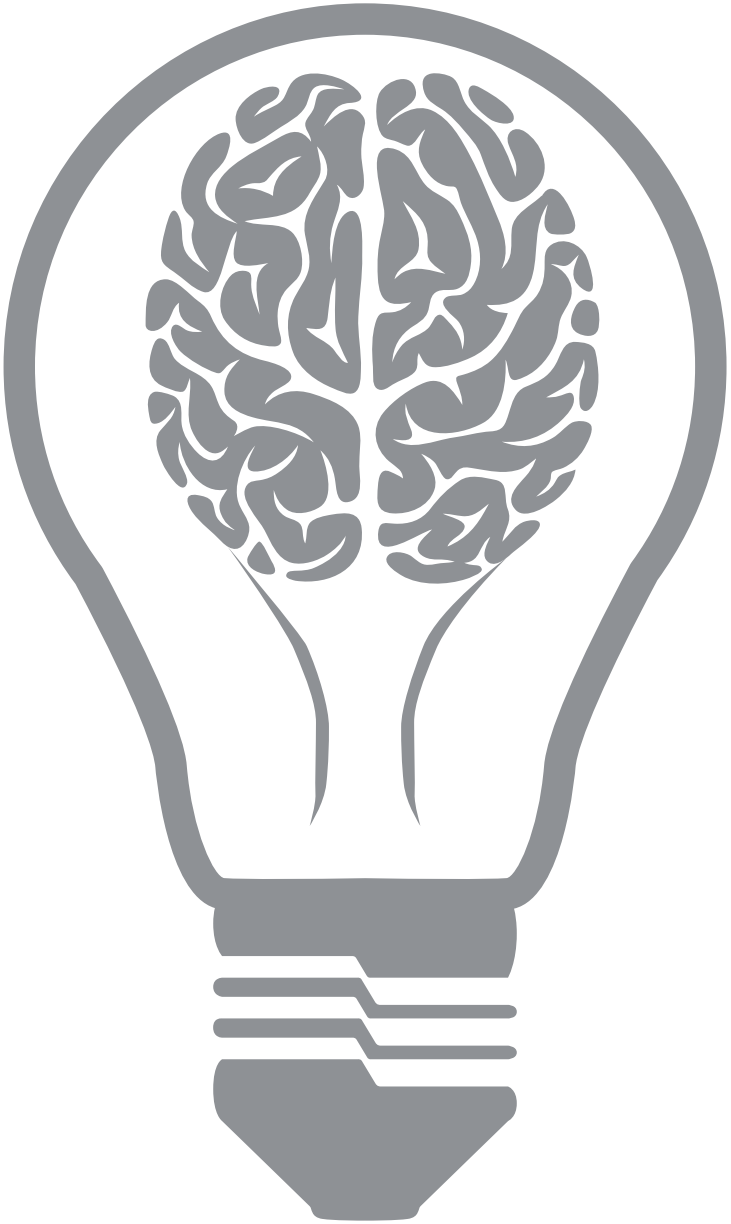
People also use patents to suppress manufacture or development of inventions—including their own—for commercial or ideological reasons. Conversely, some patent holders have released their inventions into the public domain before the patent term has expired, lodging the patent only to ensure a public record of the invention and to prevent others from gaining a monopoly on its use.

Patent applications generally have four elements:

- **An abstract:** a summary of the important technical features of the invention.
- **A description:** discloses the details that would allow others to know how the invention works and how it can be made.
- **Claims:** legal statements that set out the technical features of the invention that are intended to be protected by the patent.
- **Drawings:** if relevant, drawings should be included to aid understanding of the description of the invention.


T. A. EDISON.
Electric-Lamp.
No. 223,898. Patented Jan. 27, 1880.
Fig 1.
Fig 2.
Fig 3.
Inventor
Thomas A. Edison

Thomas Edison's patent for the light bulb ('electric-lamp') was granted on January 27, 1880.



Who Grants Patents?

Patents are granted by governments. Most countries will have a national patent office that carries out any examination work.

There are also regional offices that carry out work on behalf of several countries; for example, the European Patent Office and the African Intellectual Property Organization. Where applications are made to one of the regional offices, these can be submitted to one or more of the countries within that region; each country retains the ability to grant or refuse the patent independent of the others.

Similarly, the World Intellectual Property Organization allows the filing of one patent that can act as an application in any country that is a signatory of the Patent Cooperation Treaty, currently 152 countries.

Patent terms

The lapse of a patent is seen as a net social benefit as it allows others to build upon the invention without restriction, possibly leading to newly beneficial innovations. Technology is built upon previous technology; if patents lasted forever, the pace of innovation would slow for the sole benefit of the enrichment of a few. Thus, most countries deem 20 years a pragmatic balance between protecting the commercial opportunities of an inventor and the wider social good of allowing a patent to enter the public domain. Many countries operate systems whereby annual maintenance fees must be paid, without which the patent will lapse.

After a patent has expired, the invention can be used by anyone as they see fit. For products that are still popular, this can lead to a flood of imitations from new entrants to the market, driving prices down for the consumer, and can lead to rapid acceleration of technological improvements to the product as companies compete against each other for the market share. It can also produce variations of the product that are low quality and mere ‘cash-ins’ of the original.

Patent terms can be extended beyond the 20-year period in some countries in limited circumstances. In Europe, for example, supplementary protection certificates (SPCs) may be issued to compensate patent holders for regulatory delays in bringing products (such as medicines) to market. The SPC grants a maximum five-year extension to the term of the patent.

> “Founder and MD of AESSEAL® Chris Rea stopped counting the number of patents held by the company once it reached 50.”

What Can be Patented?

Though it differs from country to country, in general, for a patent to be granted it must meet the following requirements:

- It must be something that has utility; you cannot patent an idea.
- It must be new, having never previously been made public; i.e. it must have novelty.
- It must be inventive; it cannot be an improvement to an existing device that would be deemed obvious.

The first requirement means that it must be capable of being made or used in industry. The definition of industry is wide and includes such fields as agriculture. Most inventions are capable of satisfying this test.

The 'novelty' requirement essentially means that the invention can in no way have previously been in the public domain or otherwise disclosed before the patent application is made. This requirement is strict, but interpretations of novelty can include as simple a variation as using a nail instead of a screw for a particular task.

The example of the screw may instead fail the requirement for inventiveness. Even if an invention is found to be novel, patent applications can still be rejected if an examination determines that the claims made in the application would be obvious to a person skilled in the field if exposed to a combination of existing documentation.

What Can't be Patented?

Again, the requirements differ from country to country, though will be similar across most of the world. According to the UK government, the following 'inventions' cannot be patented:

- Literary, dramatic, musical or artistic works.
- A way of doing business, playing a game, thinking.
- A method of medical treatment or diagnosis.
- A discovery, scientific theory or mathematical method.
- The way information is presented.
- Certain computer programs or apps.
- Certain 'essential' biological processes, such as cross-breeding plants, or animal varieties.

> "Once a patent application has been filed, no new material can be added; even where a minor mistake needs correcting, this is prohibited if the mistake relates to the core inventive feature."

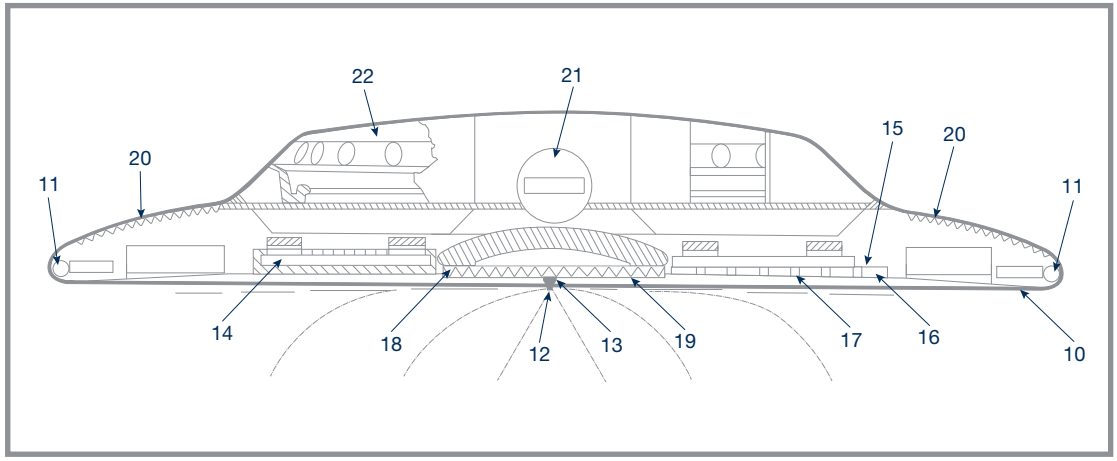
Value of Patents to Manufacturing

According to an analysis of figures 1998 to 2008, only 1.6% of registered firms in the UK make use of the patent system.

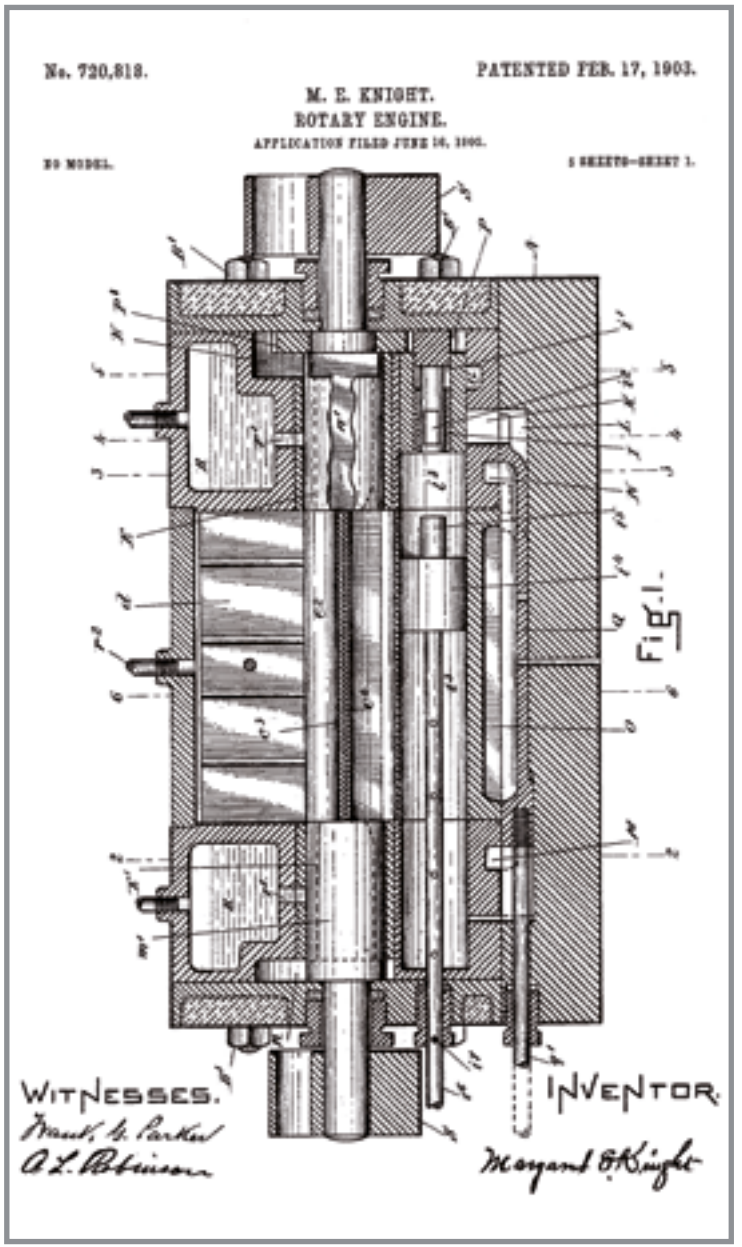
Of those who have engaged in some form of research and development, only 4% applied for UK or European patents. Narrowing the analysis to only those firms engaged in high-technology manufacturing, the figure is still only 10%, and for those high-tech firms that also commit to research and development the figure rises to 16%. There are similar results in other countries; a 2011 study found that only 5.5% of US manufacturing firms own a patent.

But why is it important for a manufacturing company to patent its innovations?

- The patent provides complete freedom for a company to operate within its sector, without fear that a competitor has been granted a patent on the same idea.
- For smaller companies, it removes the fear that a larger competitor will be able to undercut prices on the same product using economies of scale.
- The patent can provide a revenue stream through licencing opportunities, even to competitors.
- Patents can increase the value of the company, which is the sum of its physical and intellectual assets.
- Through the creation of 'prior art', patents protect the company from potential claims of infringement from others, even years in the future.



In 1973, the UK Patent Office granted a patent for the British Rail flying saucer; the patent lapsed in 1976 owing to non-payment of maintenance fees.



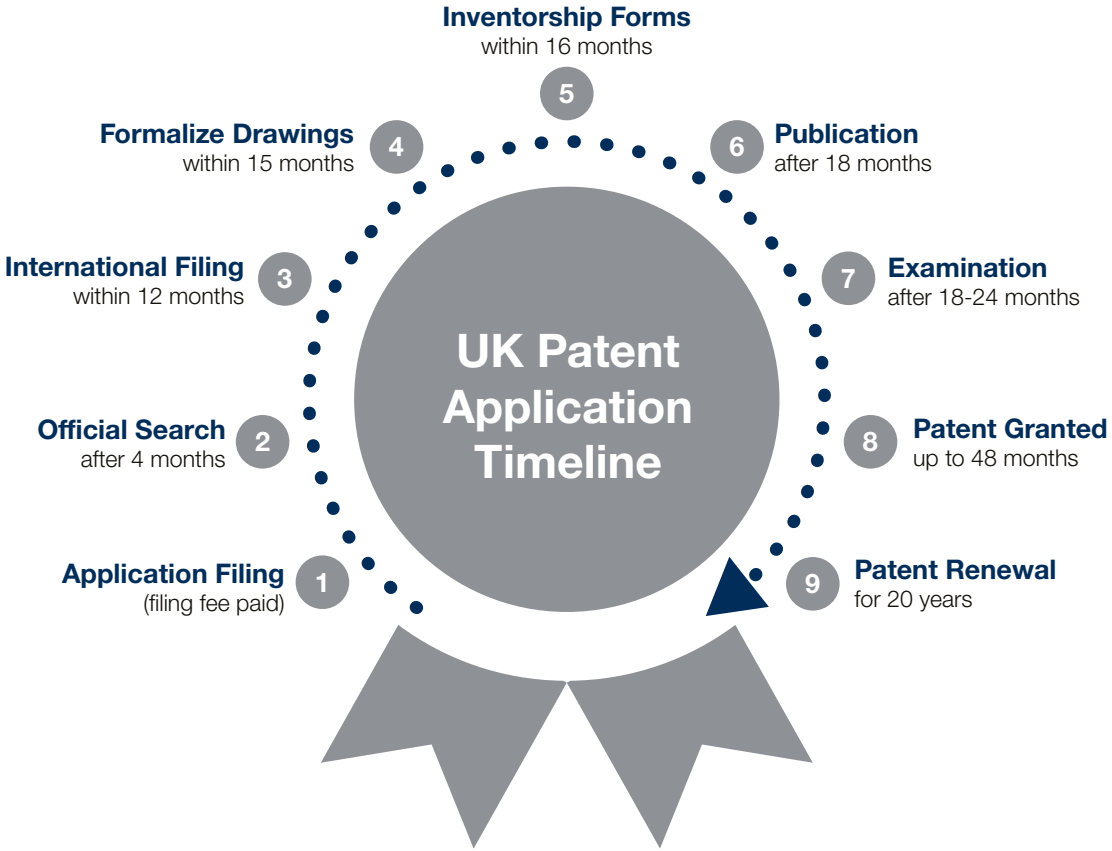
Drawing from a patent application for a rotary engine (1903) —an early type of internal combustion engine.

Path to a Patent

A patent application must go through many steps before being granted. The UK's procedure is typical of such processes:

Before filing a patent application, inventors may wish to conduct their own search of existing patents and other publicly-known information to ensure that the patent meets the necessary criteria. Research for such 'prior art' can help to avoid costly applications for inventions that already exist. Just because there is no product on the market, it does not mean there is no patent for it. Most patent applications worldwide fail the novelty test.

One common mistake by inventors is to publicly demonstrate their device prior to applying for a patent. Such demonstrations, advertisements or newspaper articles can mean the possibility of being granted the patent is low.



1 — Application Filing

The patent application will typically consist of an abstract, a full description of the device, the featured claims of the patent and drawings or sketches. This is the stage at which a filing fee is paid.

2 — Official Search

The Intellectual Property Office (IPO) will carry out a preliminary examination to ensure the application meets certain formal requirements. The applicant can then pay a fee for the IPO to search through existing patents and other material to help assess whether the invention is new and inventive; this is a basic analysis that is typically returned after about 4 months. It is at this stage that the IPO may discover prior art, or even a potential infringement of another patent.

3 — International Filing

An applicant has 12 months from initial filing to decide to apply for patent protections in foreign territories covered by international patent treaties.

4 — Formalize Drawings

It will be necessary to formalize the application drawings within 15 months of filing. Any rough sketches or informal drawings should be replaced by ones which meet the IPO's rules for 'clear reproduction'.

5 — Inventorship Forms

If the applicant is not the inventor, or is not the sole inventor, then the IPO must be notified of this within 16 months of filing.

6 — Publication

Around 18 months after filing, the IPO will publish the application. This allows anyone to view the details of the invention and the drawings.

7 — Examination

Typically beginning 18–24 months after filing, the IPO examiner will issue a report which may ask the applicant to address issues, such as those relating to uniqueness or inventiveness. After changes have been made to the application, it can take up to six months for the examiner to respond and either request further clarifications or move on to the next step.

8 — Patent Granted

Typically occurring up to 48 months after filing, the IPO will either grant or refuse the patent application.

9 — Patent Renewal

Annual renewal fees must be paid until its expiry 20 years after filing.

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION

Six Queen's Awards for Innovation

AESSEAL® has focused on innovation since it began designing and manufacturing its own product ranges in October 1981.

A relatively small manufacturing company, AESSEAL® needed a significant advantage to succeed in a highly competitive industry. The answer was an industry first in mechanical sealing - a modular product range. In 1988, AESSEAL® won its first Queen's Award for Technical Achievement for the Universal Self-Aligning component in its mechanical seals.

Between 1998 and 2002 it embarked on a program to create a modular family of products, so innovative and offering such exceptional performance that it would have a significant competitive advantage. The result was a range that boasted four granted international patents, three patent pending applications and one registered design patent: in total eight separate and unique product innovations that accounted for significant sales growth. Through investment in innovative new products and technology with a total focus on customer service, AESSEAL® had a simple but effective formula which led to a second Queen's Award for Innovation in 2004 for API seals that are used in the refinery and petrochemical industries.

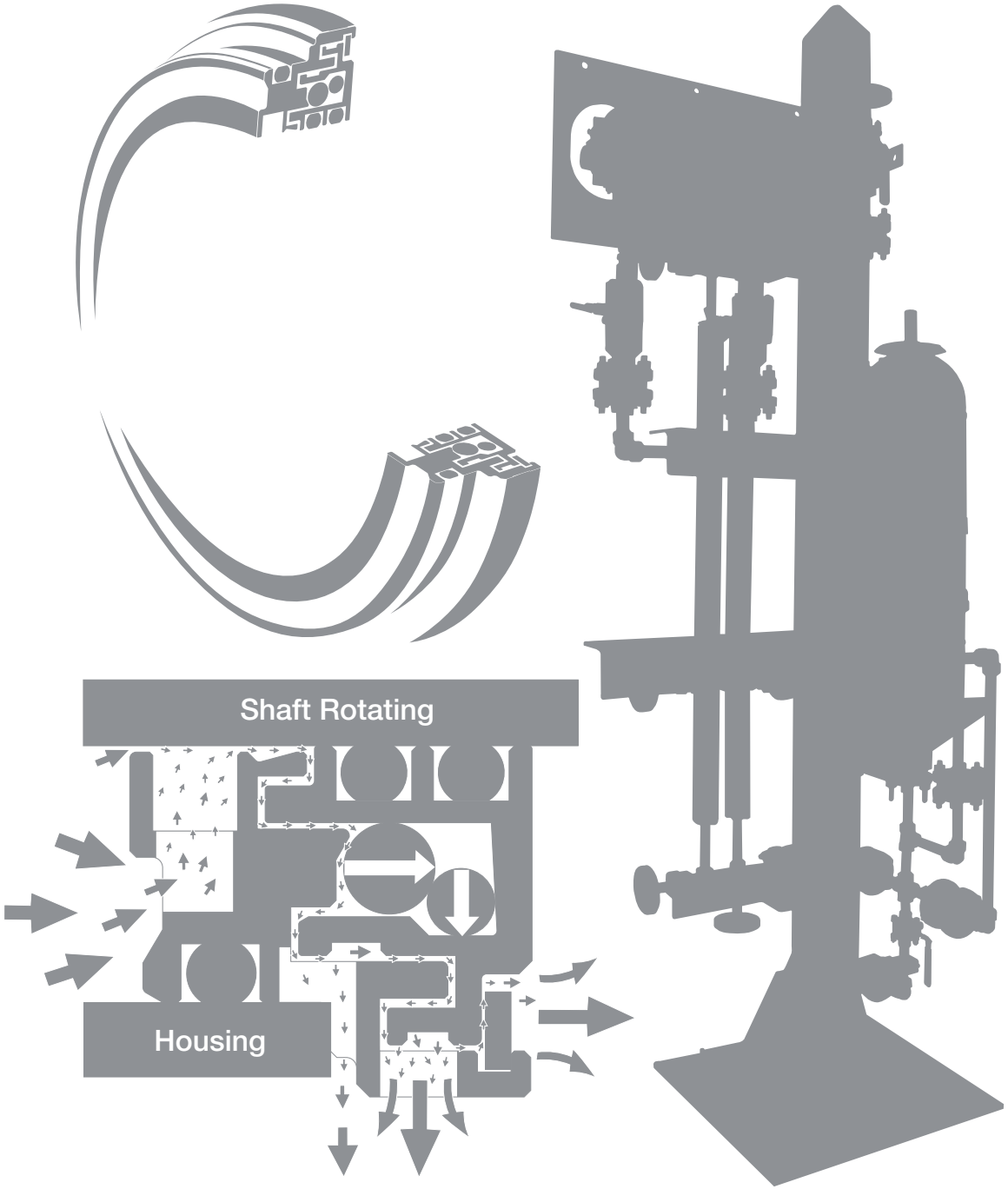
The unique, patented, bi-directional, integral pumping design, part of the AESSEAL® API range.

AESSEAL® invented a product in 2002 that opened a whole new area of business: bearing protection. The rotating equipment sealed by AESSEAL® also contained bearings, most of which were protected by lip seals, which are ineffective in preventing contamination and the escape of bearing oil. The AESSEAL® development team invented the world's first double magnetic bearing isolator: the MagTecta™, which was a more effective sealing device that extended equipment life and in 2006 won AESSEAL® a third Queen's Award for Innovation.

In 2009 AESSEAL® received a further two Queen's Awards for Innovation. Four Queen's Awards in a single year and 11 awards in total was an astonishing achievement for the AES Engineering Group on its 30th Anniversary. The fourth Queen's Award for Enterprise: Innovation was for the AESSEAL® LabTecta® Bearing Protector. AESSEAL (MCK) Ltd, located in Belfast, Northern Ireland, was also awarded the fifth Queen's Award for Enterprise: Innovation, for designing the 'Flow Fuse' for mechanical pump seals.

In 2016 AESSEAL® was awarded its sixth Queen's Award for Innovation—its thirteenth Queen's Award overall. This was for the development of a novel approach to the supply chain for its seal support systems. Traditionally, these systems were individually tailored to a required specification, resulting in long lead times that were inconsistent with those for the mechanical seals themselves. The new modular approach to systems allowed complex systems to be swiftly assembled in times much more in line with those of mechanical seals.

For further information about the Queen's Awards visit the Queen's Awards website: **www.gov.uk/queens-awards-for-enterprise**



Case Study – an AESSEAL® Patent

One of AESSEAL's earliest patent applications was filed in 1992 by Chris Carmody PhD, MSc, BEng, who as of 2019 is still with the company.

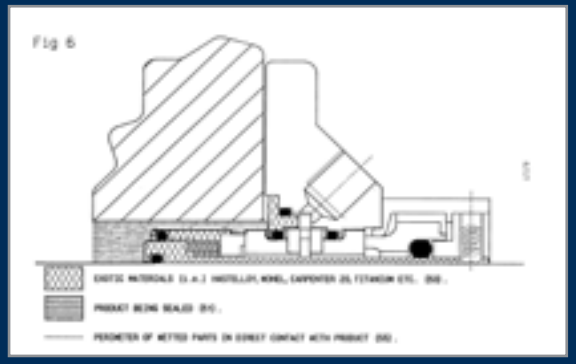
Given UK patent number GB 2260376A, the patent was for a simple modification that would reduce the cost of manufacturing a mechanical seal without compromising its efficiency. The substance of the patent document goes on to describe the basic makeup of a cartridge-mounted mechanical seal such as this one, and the specific problem the innovations of this invention were intended to solve.

A problem to solve

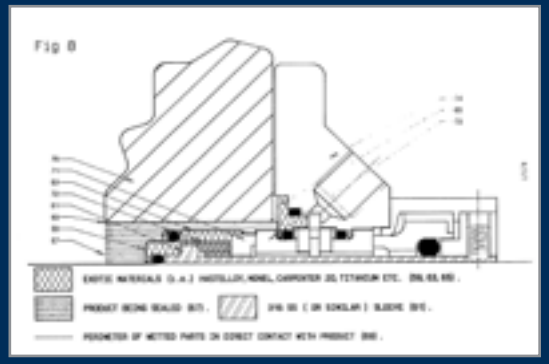
Ordinarily, the mechanical seal comprises two main parts: a rotating element and a stationary element. The primary rotary element in this case is driven by a sleeve (item 23, circled right), which is fixed to the shaft. The stationary element is fixed to the body of the equipment. The sleeve is typically manufactured from stainless steel and includes a groove to accommodate an o-ring seal (item 30, circled right).

The sleeve can also be manufactured from expensive alloy materials, which is often necessary when the product being sealed is toxic and/or corrosive. When the patent was written, the cost of these alloys (such as Hastelloy B or C, Monel, Nickel 200) could be up to 10 times the cost of the equivalent material in stainless steel.

In addition, they were generally only available for machining from solid bar form in fewer sizes, so waste was also high if a sleeve had to be manufactured from these materials. As the exotic alloys are harder to machine than stainless steel, cutting times were typically three times longer than normal.



Area of contact by the product being sealed on a standard one-part rotary sleeve.



Area of contact by the product being sealed on a bi-metal rotary sleeve.

Solution - first aspect

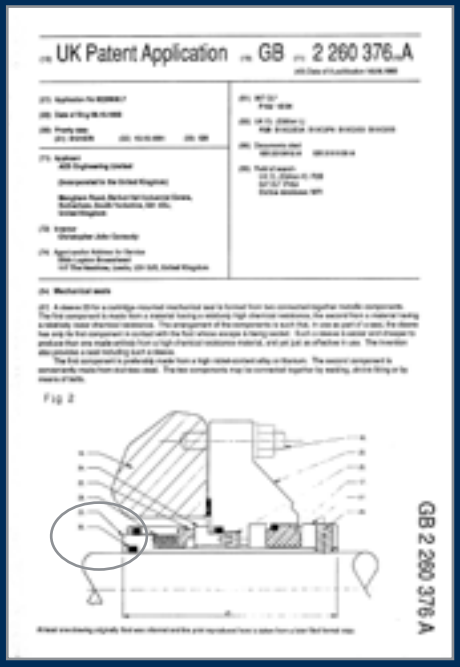
The first aspect of the innovation concerns the rotary sleeve. The patent document describes the idea of splitting the rotary sleeve into two parts. The longest part of the rotary sleeve, which does not come into contact with the product, is manufactured from standard materials, such as 316L stainless steel. The shortest section of the rotary sleeve, which contains the internal o-ring groove and does come into contact with the product, is to be manufactured from the exotic alloy necessary to withstand the toxic and/or corrosive nature of the product.

Abstract

The patent abstract reads in part:

"A sleeve for a cartridge-mounted mechanical seal is formed from two connected-together metallic components. The first component is made from a material having a relatively high chemical resistance, the second from a material having a relatively lower chemical resistance."

The abstract goes on to describe an arrangement of a two-part rotary sleeve for a mechanical seal where only the part manufactured from a material of high chemical resistance will be contacted by the product being sealed, its use with a mechanical seal and methods of securing the two parts together.

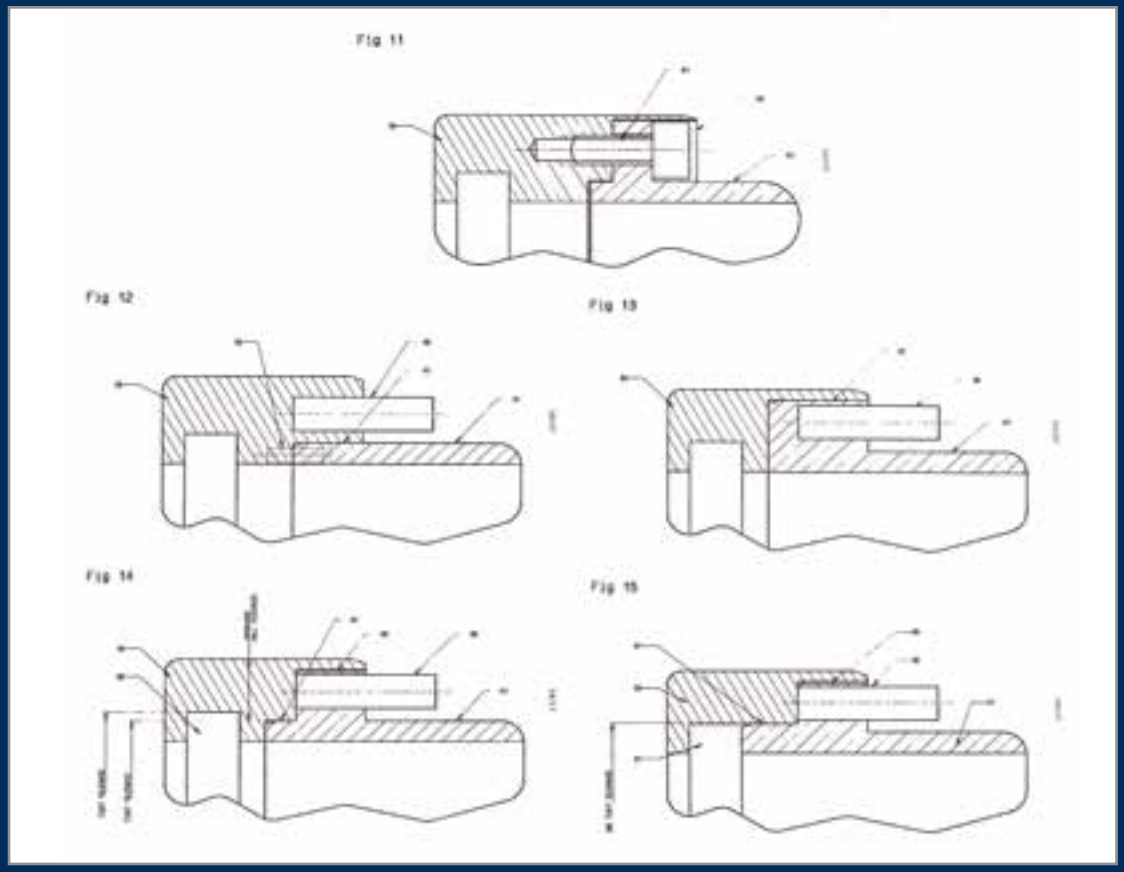


First page of the patent application.

Solution – second aspect

The second aspect of the innovation relates simply to the use of existing technology with the bi-metal rotary sleeve, describing in the patent application a “cartridge-mounted mechanical seal including a sleeve in accordance with the first aspect of the invention”. This part of the application also describes the ways in which the rotary component might interact with the rotary sleeve; for example, locating the drive pins in either the first or second part of the rotary sleeve, and where it might be desirable to do one or the other.

The second aspect also describes the self-aligning technology of the seal; this was actually covered in a previous European patent held by AESSEAL®, incorporated here to ensure “the teachings of that document [are] intended to be incorporated into this, but comprising a sleeve in accordance with the first aspect.” Essentially, this second aspect was an attempt to ensure the new patent covered not only the innovation of the bi-metal sleeve in isolation, but also its use in conjunction with several other existing technologies.

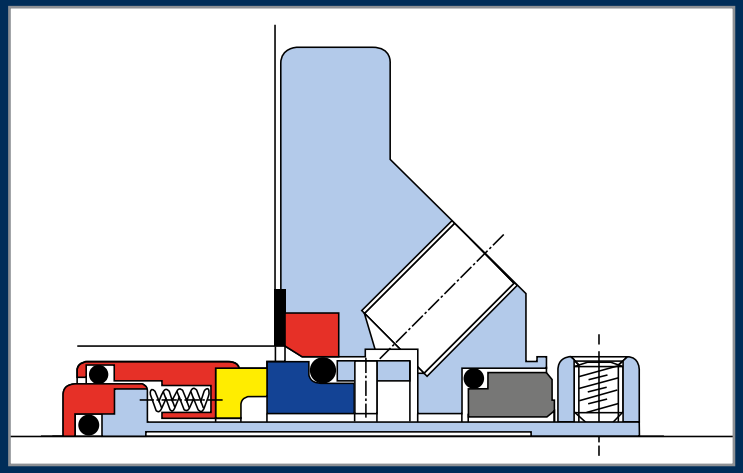


The patent describes several different methods by which the rotary halves can be fixed together, including bolting and shrink fits.

Claims

Despite containing only two main aspects, the patent application itself makes a total of 25 separate claims. The first claim represents the bi-metal nature of the sleeve; the next four claims describe combinations of materials from which the two parts of the sleeve can be manufactured.

Similarly, most of the remaining claims are concerned with the combinations of technologies, limiting the opportunities of competitors to produce patentable variations. The patent for the bi-metal sleeve was granted in 1995. As of 2019, the sleeve remains an essential offering for CURC™ mechanical seals.



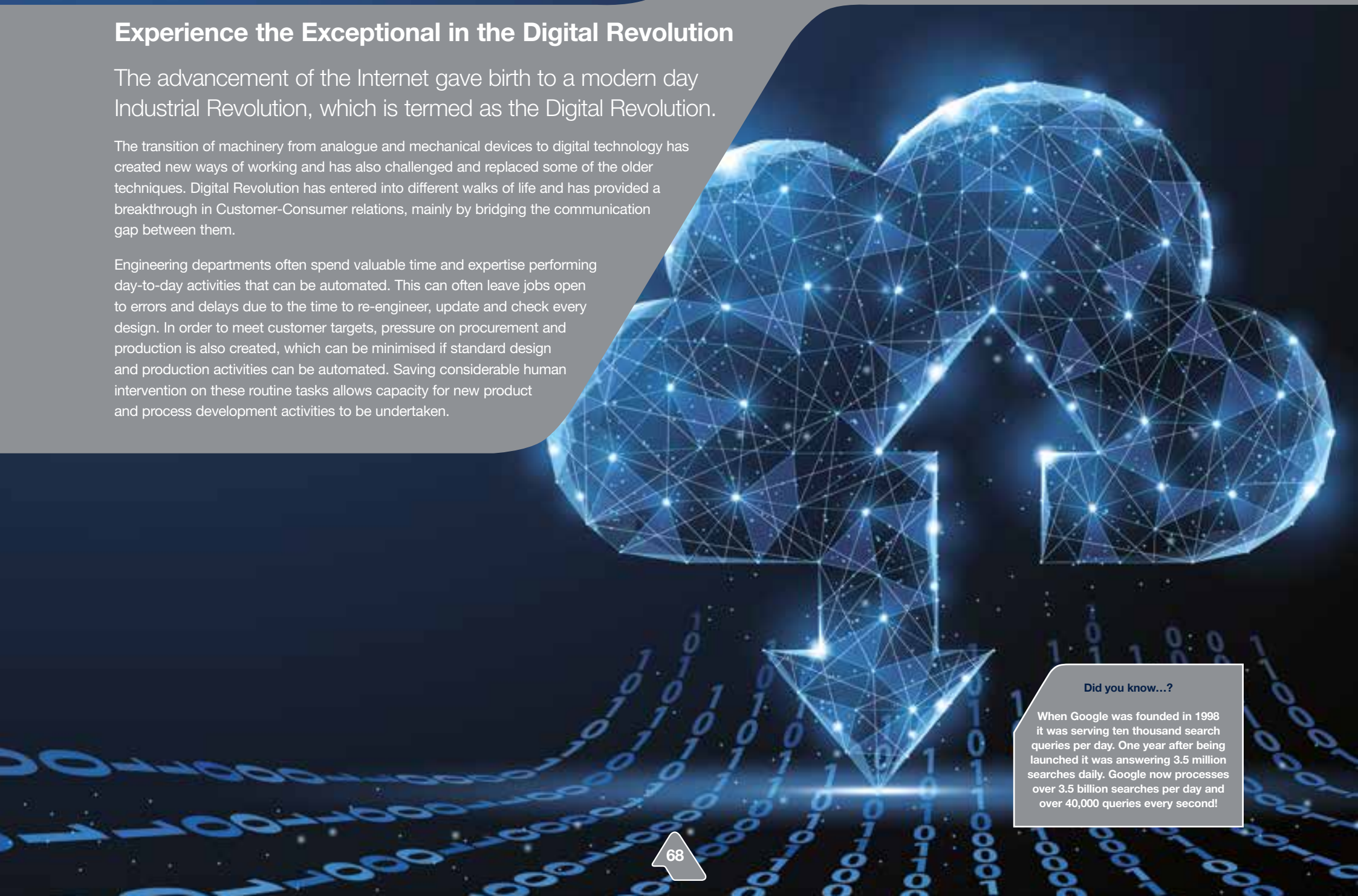
CURC™ bi-metal sleeve.

Experience the Exceptional in the Digital Revolution

The advancement of the Internet gave birth to a modern day Industrial Revolution, which is termed as the Digital Revolution.

The transition of machinery from analogue and mechanical devices to digital technology has created new ways of working and has also challenged and replaced some of the older techniques. Digital Revolution has entered into different walks of life and has provided a breakthrough in Customer-Consumer relations, mainly by bridging the communication gap between them.

Engineering departments often spend valuable time and expertise performing day-to-day activities that can be automated. This can often leave jobs open to errors and delays due to the time to re-engineer, update and check every design. In order to meet customer targets, pressure on procurement and production is also created, which can be minimised if standard design and production activities can be automated. Saving considerable human intervention on these routine tasks allows capacity for new product and process development activities to be undertaken.



Did you know…?

When Google was founded in 1998 it was serving ten thousand search queries per day. One year after being launched it was answering 3.5 million searches daily. Google now processes over 3.5 billion searches per day and over 40,000 queries every second!

The Digital Revolution

The Digital Revolution is both a manifestation and result of the emergence of information communication technologies and, thus, inaugurates the information age.

It dictates widespread use of digital logic circuits and its associated technologies: computers, cellular phones and fax machines.

Technology through the years

The changes in technological advances have brought about a breakthrough in automating design and manufacturing activities, put together in one process.

Even though the digital revolution was formally initiated with the use of computers and fax machines in 1990, it actually dates back to 1947 with the invention of the transistor that paved the way for advanced digital computers.

Historical milestones

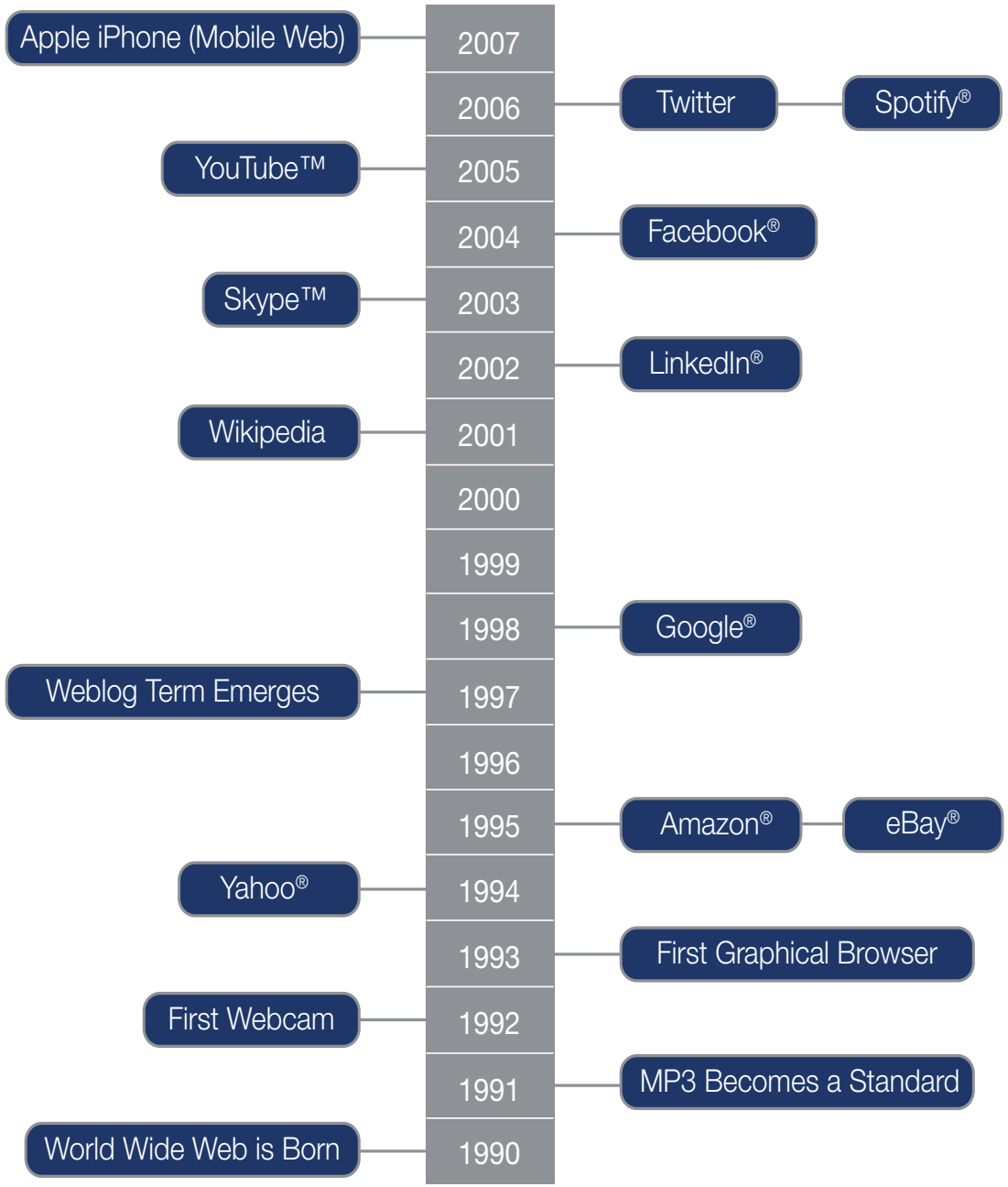
1947: The transistor was invented. In 1950s-60s, governments and military organizations started using computer systems, which eventually led to the creation of the World Wide Web.

1980: First mobile phone was invented. At the same time, the use of computers widened across the masses, becoming a necessity rather than a luxury.

1990: The world wide web is born, the internet was in common use by 1992.

2000: Television sets started using digital signals rather than analogue signals.

2010: Internet sites and mobile gadgets became a standard of communication.



Evolution of the World Wide Web.

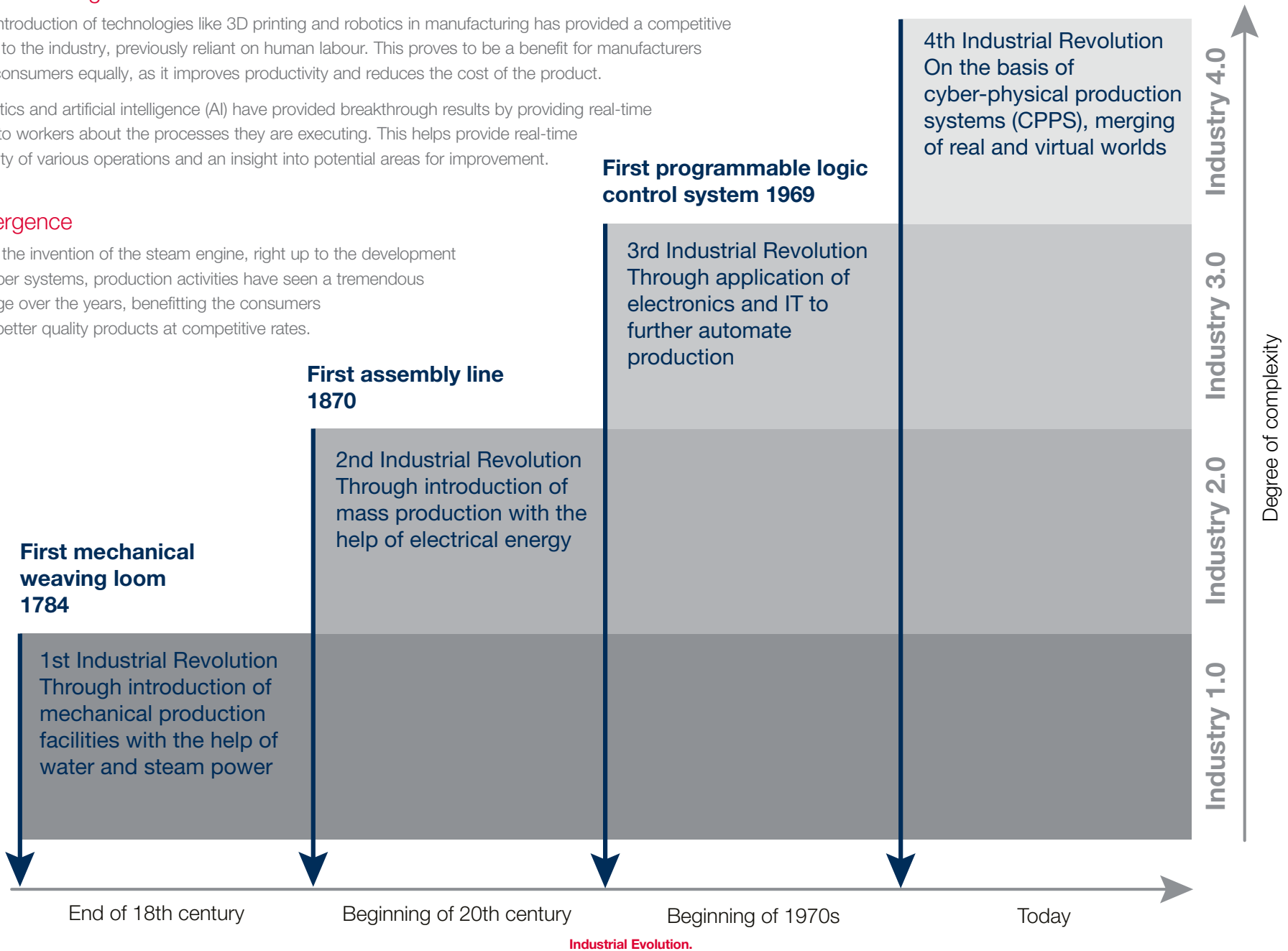
Manufacturing

The introduction of technologies like 3D printing and robotics in manufacturing has provided a competitive edge to the industry, previously reliant on human labour. This proves to be a benefit for manufacturers and consumers equally, as it improves productivity and reduces the cost of the product.

Robotics and artificial intelligence (AI) have provided breakthrough results by providing real-time data to workers about the processes they are executing. This helps provide real-time visibility of various operations and an insight into potential areas for improvement.

Emergence

From the invention of the steam engine, right up to the development of cyber systems, production activities have seen a tremendous change over the years, benefitting the consumers with better quality products at competitive rates.



Industrial Evolution.

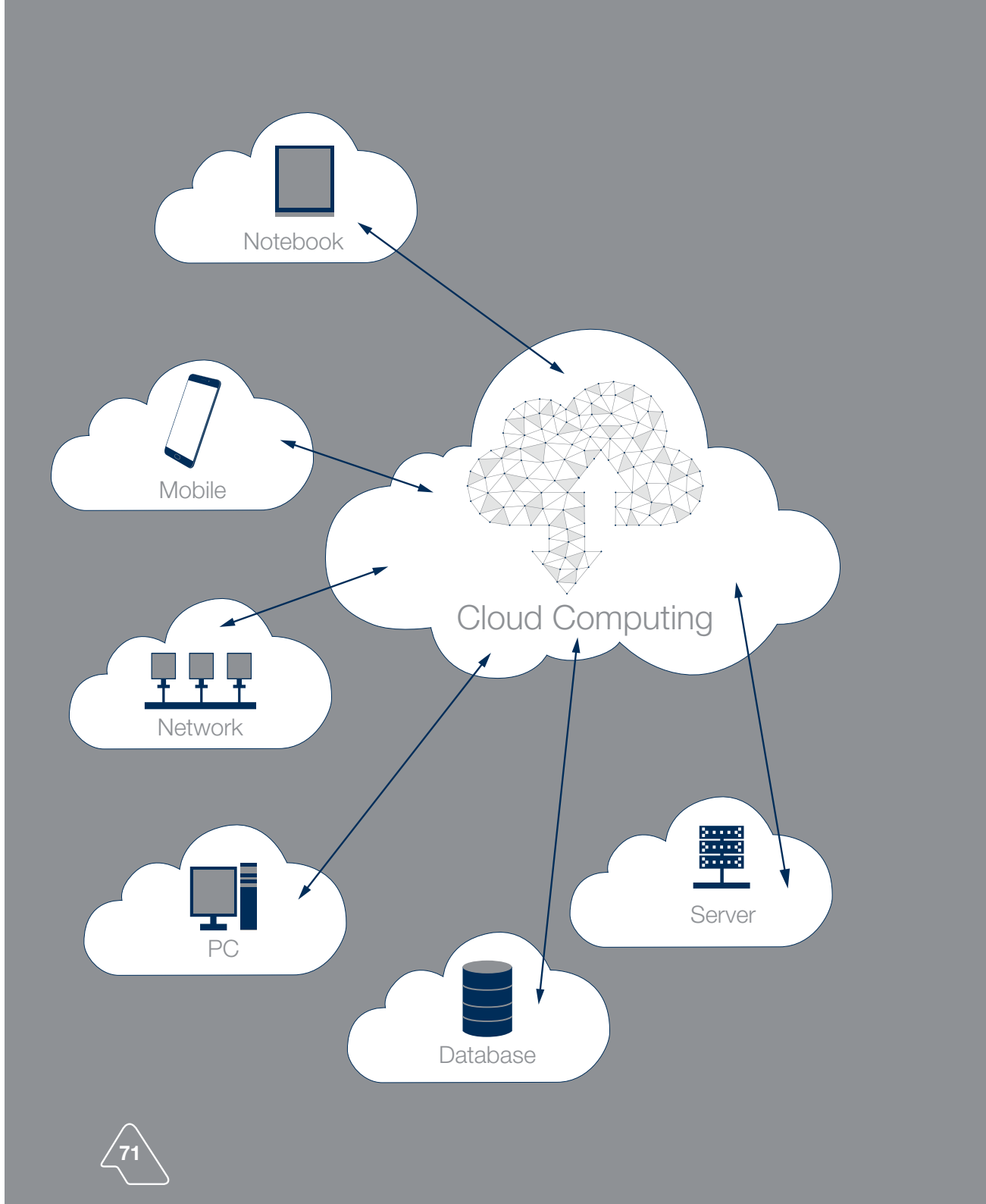
The Development of Cloud

The aim of design automation is to provide flexibility in the design of the seal in a reasonable time-scale, fulfilling the customer's requirements.

At AESSEAL®, one of the areas where the concept of artificial intelligence and cloud technology can be of advantage is to automate the design of mechanical seals with various different materials and configurations.

With 40 years of sealing experience and a customer base across different industries like pulp & paper, oil & gas, etc, AESSEAL® has the advantage of accumulating a vast database, that can be uploaded and utilized to offer a product suitable for an application, without manually going through the process of searching the database for previously used applications.

The idea is to input the data remotely from any corner of the world and get the seal design and the CAM program generated, with human intervention for supervisory purposes only.

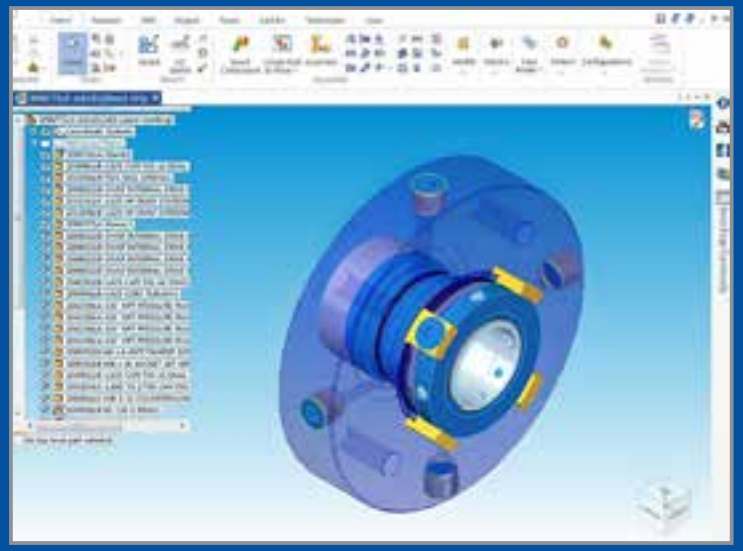


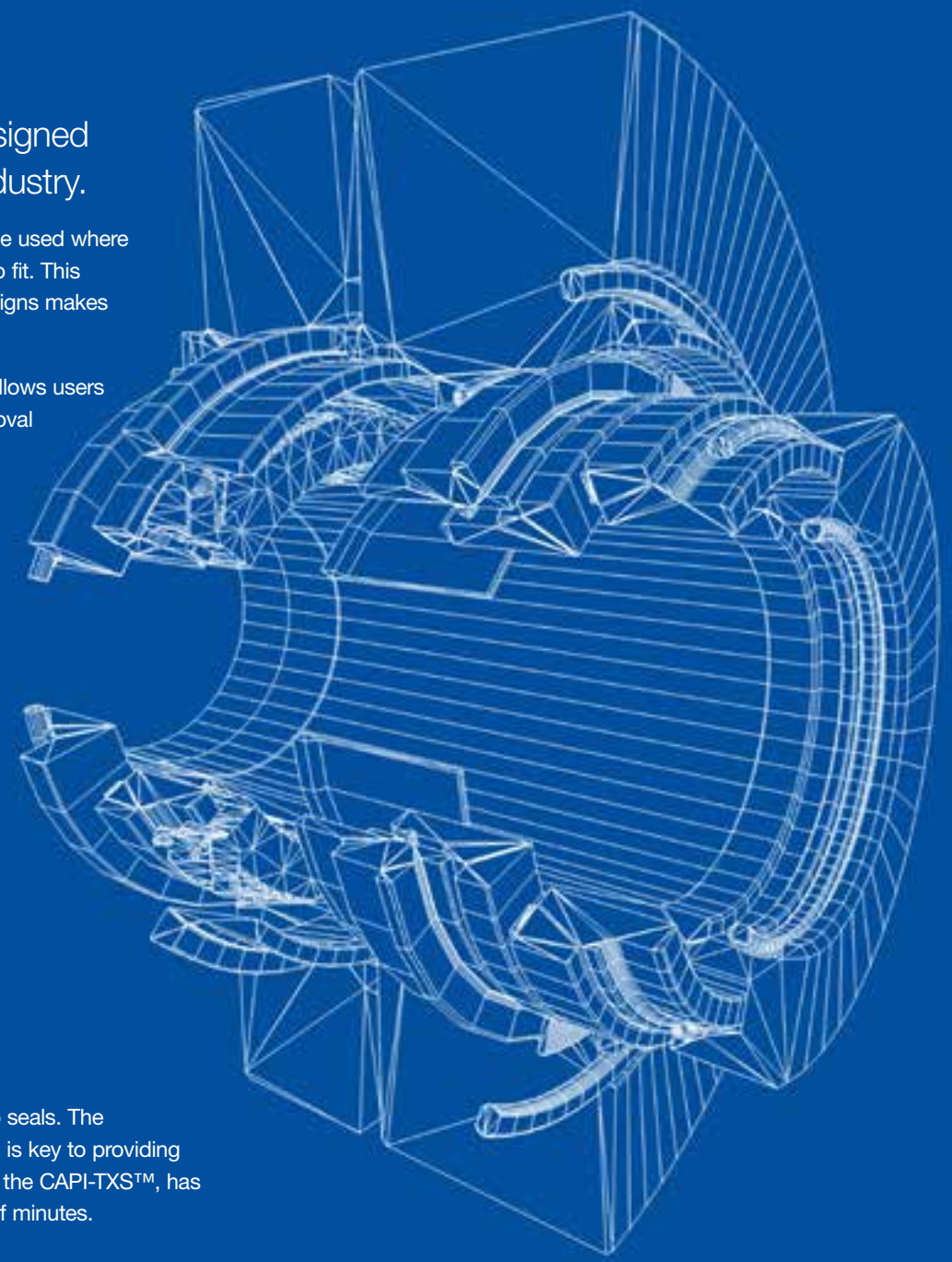
CAPI-TXS™ Design Automation

The AESSEAL® CAPI™ range is a leading range of API 682 compliant mechanical seals, specially designed for API 610 pumps, typically used in the oil & gas industry.

CAPI-TXS™ seals are designed with a thin rotary cross section allowing them to be used where space constraints in the seal chamber do not allow standard API cartridge seals to fit. This versatility and the fact that early edition pumps commonly require customized designs makes the CAPI-TXS™ the perfect product to be the first cartridge seal to be automated.

In order to make it as easy as possible for customers, the cloud-based software allows users to enter the dimensions and materials they require. The 3D model, customer approval drawing and CAM programs are automatically generated in minutes. In the future the user will not only receive a drawing to approve but also a quote.





LabTecta®OP

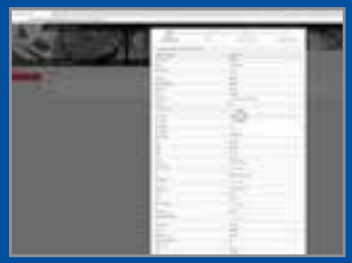
AESSEAL® also offer a range of bearing protection products aimed at replacing lip seals. The speed and efficient design of these products to suit customers' bearing chambers is key to providing exceptional customer service. For this reason, the design of the LabTecta®OP, like the CAPI-TXS™, has been automated, allowing customers to receive a customized design in a matter of minutes.

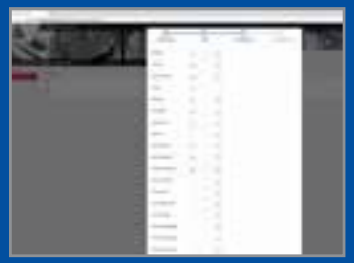
AESSEAL® — The Challenger Brand

How can we reduce the time it takes for customers to receive a customized design?

Could hours / days / weeks be reduced to a matter of minutes?
Imagine what this could do in industries where there are ageing assets not designed to a set standard…

What if you could enter the materials, dimensions and parameters on a mobile device and receive a drawing back for approval?



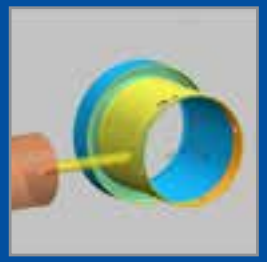


What if you combined this capability with AESSEAL®'s knowledge database and generated AESSEAL® standard designs specifically for pump models? Would this be revolutionary? Would it be possible?

AESSEAL® **knows it is!**

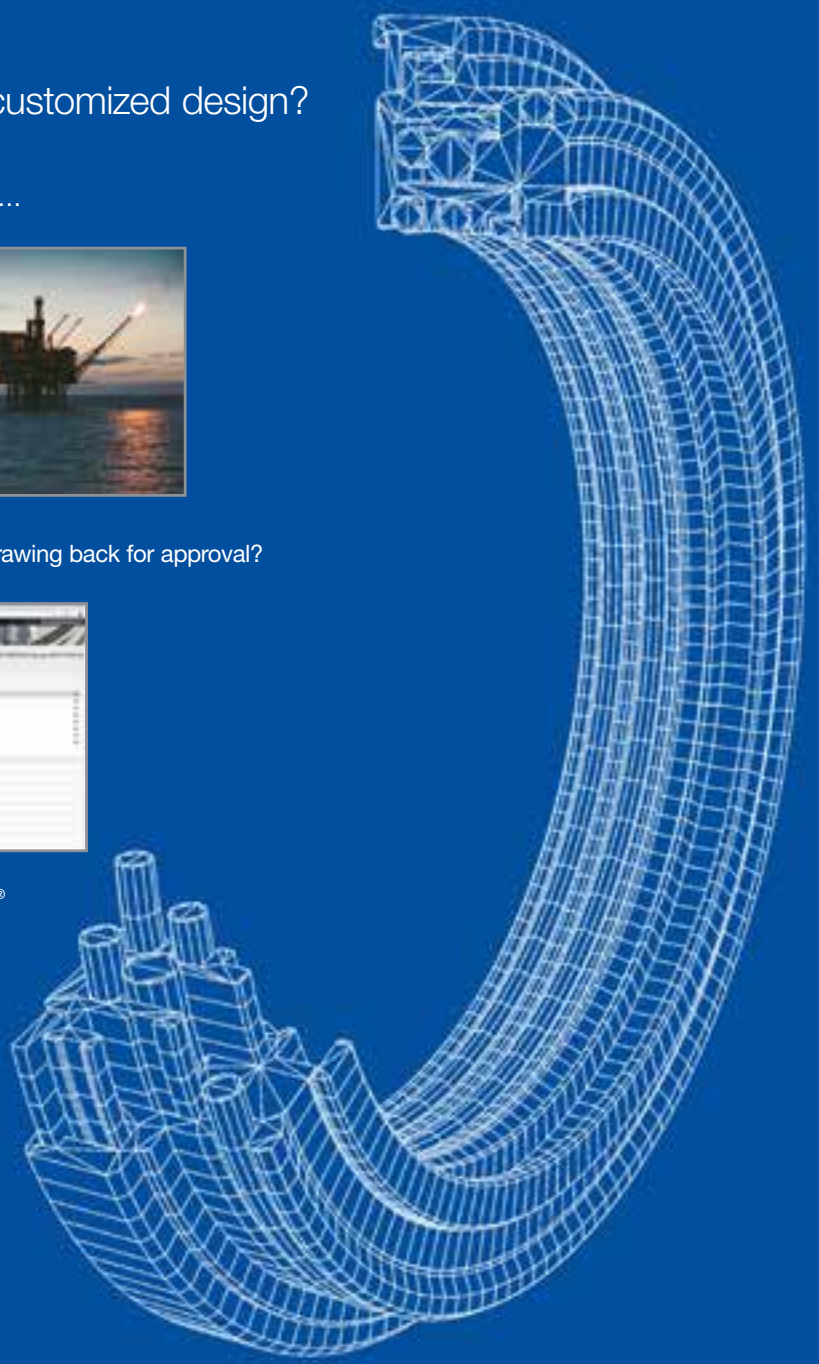
3D model.

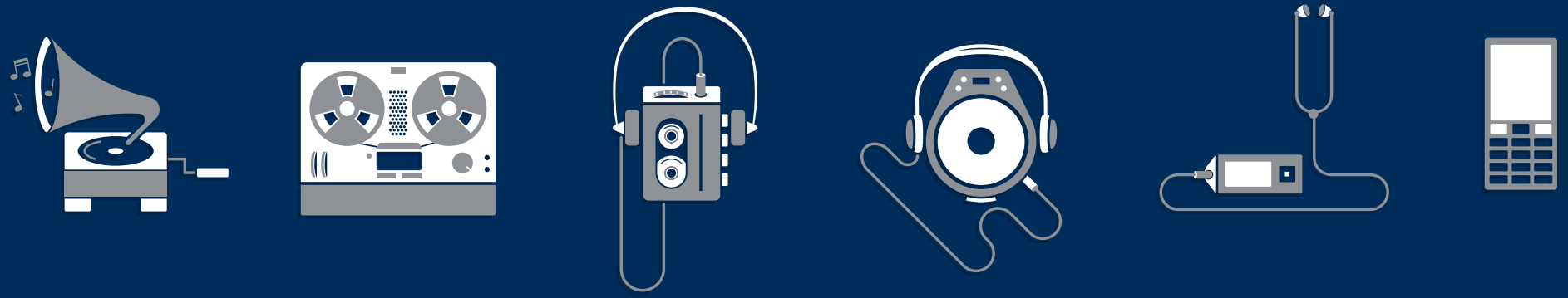
Customer approval drawing.



CAM program.

CMM program.





The Latest Technology in Old Equipment

One of the problems of living in a modern, fast changing world is that things can rapidly become out of date and can no longer be configured to work with the latest technology.

In a consumer world, such as the audio industry, it is a minor inconvenience to the user that the latest MP3 player will not play his / her beloved vinyl records. However, in the industrial world, the problem is much more than a “minor inconvenience”.

Industrial capital equipment can cost many tens of thousands of £ / $ / € and plant-wide rotating equipment can cost multi-millions of £ / $ / €. It is not uncommon for hydrocarbon processing plants to be operating equipment originally purchased in the 1970s or earlier, because it is not commercially viable to keep replacing it with newer models.

Unfortunately, this mature equipment had been designed to suit the seal technology commercially available at the time. In the 1970s and 1980s single spring component seals and/or shaft packing were often employed to seal many industrial applications, so rotating equipment was designed with stuffing box chambers with a 0.500” or 0.625” (10mm or 12mm) cross sectional space.

API610 is considered by many as the premium standard for the design and construction of centrifugal pumps. It is interesting to note how the seal chamber space in this specification has changed through the years (see next page, top).

As the latest API610 Ed10 specification dictates a seal chamber design with a large radial clearance for optimum seal life, practically all major mechanical seal manufacturers have designed and tested API682 seals for such spaces.

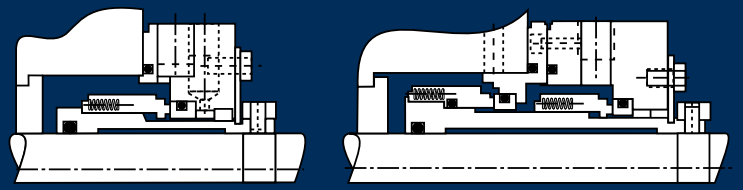
API Standard 610 - Sixth Edition.
API Standard 610 - Tenth Edition.

This offers little benefit to the plant engineer or rotating equipment engineer responsible for meeting environmental legislation with their mature equipment, as the big seals will not fit into the small spaces of the equipment.

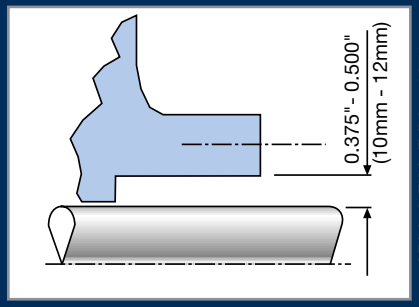
Some seal manufacturers, therefore, offer totally different and unqualified seal technology for old equipment compared to that for new equipment. Why?

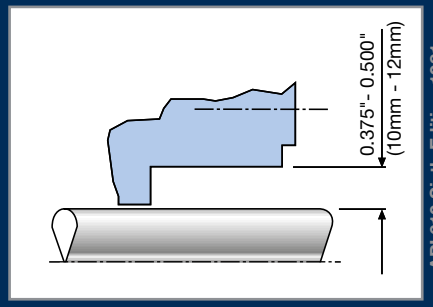
Why should today’s plant engineers not have ‘best sealing technology’ that is API682 qualified, for their mature, 1970s and 1980s equipment? After all, they still need to meet today’s environmental emissions guidelines. Why do some seal manufacturers expect plant engineers to pay tens of thousands of £ / $ / € to upgrade their equipment (and be grateful at the same time) in order to use the seal suppliers latest qualified seal technology?

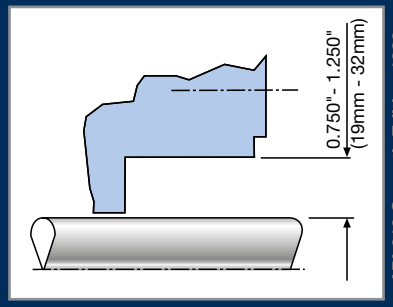
In order to comment on these issues we must understand why some seal manufacturers cannot use their qualified technology in mature equipment. Best practice guidelines, such as API682, promote the use of hydraulically balanced cartridge mechanical seals, as these are more robust for installation, and in realizing this, practically all major mechanical seal manufacturers elected to screw a ‘component seal’ onto a cartridge sleeve, as shown below.

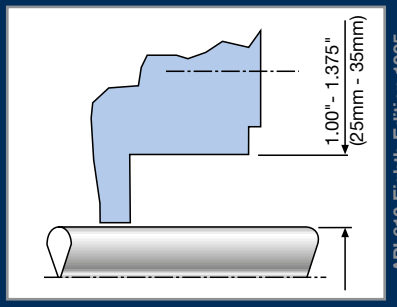


Competitor API682 Single and Dual seal Configuration.









In order to achieve balanced seal faces, the competitor cartridge sleeve has to incorporate a step. This means that the radial space of the equipment must be large enough to accommodate the rotary component seal and a stepped cartridge sleeve. In the case of a dual seal, two steps in the cartridge sleeve mean an even larger inboard rotary component seal.

Since the major seal manufacturers cannot fit 'stepped' seal face technology onto a cartridge and into 0.500"(12mm) radial space, as found on mature assets, they elect to offer different cartridge technology, which has not passed the rigorous endorsement and emission criteria of the API682 qualification test program.

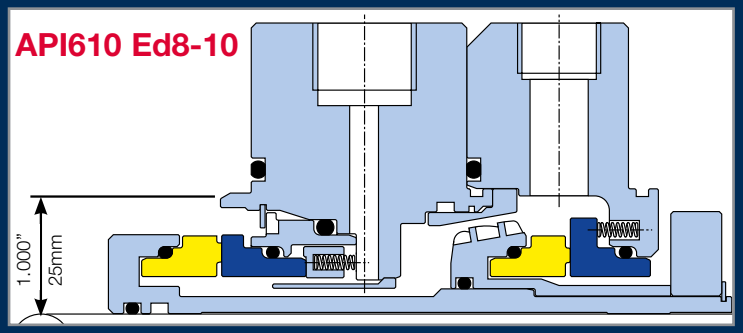
AESSEAL® took a different approach when it created its CAPI™ (Cartridge API) range. This range of API682 qualified mechanical seals, both pusher and bellows, was designed with specific consideration for both new and old equipment.

The CAPI™ range has the same qualified seal face technology for API610 Ed10 pumps as well as the API610 Ed5 pumps, and all the pump specification variants in-between, spanning more than four decades.

This means that mature equipment, designed in the 1970s and 1980s can be retrofitted with 21st century, API682 qualification tested seal face technology, without the need for equipment modification.

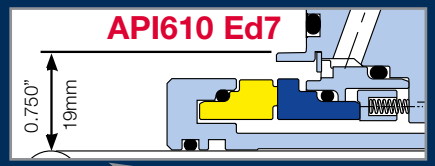
This has clear benefits for the engineers responsible for making plant equipment conform to local and government emission criteria, whilst at the same time operating in the real world with a finite capital budget.

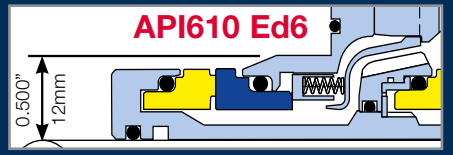
The AESSEAL® CAPI-TXS™ (Thin Cross Section) range comprises API682 Category I, cartridge single and dual seals, which use qualification tested API682 technology. As such, AESSEAL® is believed to be the only major global mechanical seal supplier that provides the end user with a viable alternative to the very costly and time consuming pump modification or replacement option.



AESSEAL® CAPI™

Identical API682 Qualified Seal Faces





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Acknowledgements

The research for and writing of this book was by the young management trainees on the AESSEAL® mentoring program...

Oil & Gas

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Kate Timms

Mining & Minerals

Tom Wood

Biofuels

Madeleine Kearney

Water Savings

Sam Padidar-Nazar

Intellectual Property

Steve Wilkinson

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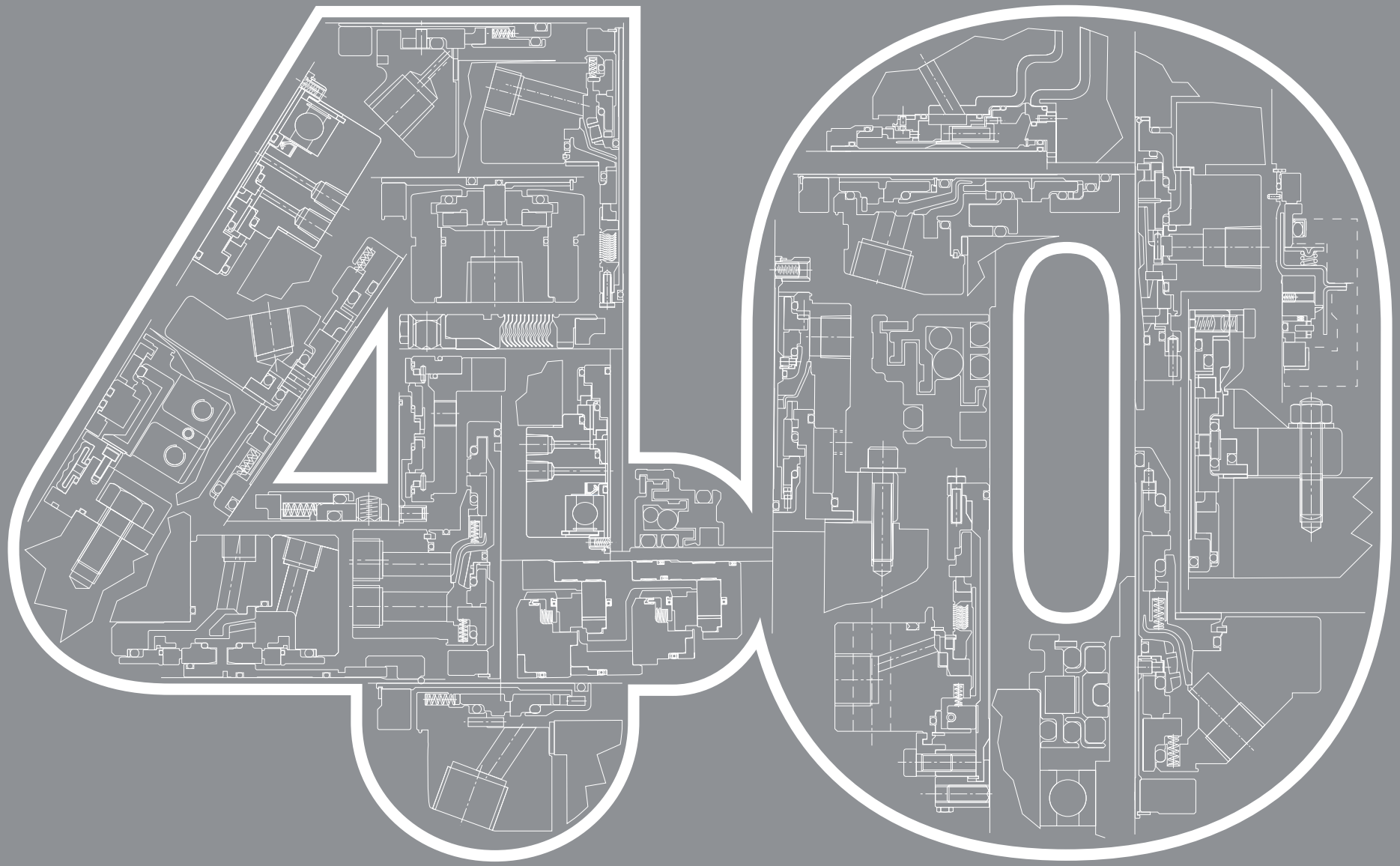
Digital Revolution

Parin Karia



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