BLUE CUBE QUARTERLY.

2017 | First Edition

TECHNOLOGY EXPLAINED

A light bulb moment

Every day when the sun sets, we extend our day by lighting up the dark for a few hours longer. This wasn't always as easy as flicking a switch.

A number of inventors have been working on prototypes since the start of the nineteenth century, but Thomas Edison patented the first incandescent bulb only in 1890.

Incandescent bulbs provide light by leading current through a filament in the form of a thin wire. Known to Edison at the time was that tungsten is the element with the highest melting point but at the time there was no machinery to manufacture a super fine tungsten wire. They had to use other materials such as carbon and bamboo until 1910.

Incandescent light bulbs are inexpensive to purchase but provide a very poor luminous efficacy (typically 5 to 15 lm/Watt). The reason is that most of the light emitted is in the infra-red region and the temperature of the tungsten filament gets as high as 2700K.

Over time there was a motivation to apply alternative technologies to light bulbs as electric lighting consumes about 20% of the world's total electricity use and improving the luminous efficacy would have significant financial and environmental benefits.

An improvement on the traditional incandescent bulb was the tungsten halogen light bulb which derives its benefits from the halogen cycle. Where the incandescent bulb contains the inert gas argon, the tungsten halogen bulb contains halogen gas. During operation the tungsten filament evaporates but the non-inert halogen gas redeposits the evaporated tungsten back to the filament. This causes the operating temperature to be higher and the light to be whiter. The luminous efficacy of the tungsten halogen bulb is between 12 and 35 lm/W. The tungsten halogen bulb has the advantage that it is compact and can be applied where narrow beams are required.

>> continue on page 2

BLUECUBE®
measurement for control

Editor: Karen Keet | kk@bluecubesystems.com **Content:** Karen Keet & Lize Cillie

In the Blue Cube MQi analyser, a tungsten halogen light is used as it is the only type that provides the wide wavelength range of light required for the application.

The standard fluorescent lamp was developed for commercial use in the 1930s. It consists of a glass tube in which low pressure mercury vapour is ionised. This ionisation causes the electrons in the gas to emit photons at UV frequencies. A phosphor coating inside the tube is then used to convert the UV light into visible light. The luminous efficacy for some types of fluorescent lamps are as good as 100 lm/W.

These days fluorescent lights are also manufactured in a compact form and are referred to as CFLs (Compact Fluorescent Lamps). These CFLs are available in different shapes and can be used to replace traditional incandescent bulbs to save energy.

Light-emitting diodes (LEDs) became commercially available in the 1960s and are more energy-efficient and longer lasting than incandescent, halogen or fluorescent lamps. LEDs are illuminated by the movement of electrons in a semiconductor material. Coloured LEDs have narrow spectral emission profiles but LEDs have developed over the years to cover wider wavelength regions. In white LEDs the emission of different colour LEDs is mixed or phosphors are used. Phosphor converted white LEDs are usually based on blue or UV LEDs, where the white light results from combining the primary blue or UV emission and the emission created by a specific phosphor layer located over the semiconductor chip.

HEALTH & SAFETY

Plastics

Every bit of plastic that has ever been created still exists today. It does not break down naturally. And it is not going anywhere. What exactly are the risks to human health and to the environment and what can we do to manage it?

Human Health

When last did you think about that drawer in your kitchen full of reuseable plastic containers you use to store and reheat leftovers in? Many people do not know that these above are leaching chemicals into their food, and not only when heated. Plastic contains a chemical called Bisphenol A(BPA) that is absorbed by the human body. Once ingested, it mimics estrogen in the human body. Thereby disruptig hormonal balance and the endocrine system. These chemicals are also known to promote the growth of breast cancer cells and may cause low sperm count, to name only a few. We are exposed to these chemicals from plastics almost every day through the air, water, food and the use of consumer products. For example, phthalates, a chemical used to increase the flexibility, transparency, durability, and longevity of plastic, is used in the manufacturing of vinyl flooring, food packaging and medical devices. Polybrominated diphenyl ethers(PBDE), which are added to foam furniture cushions, mattresses and carpets, are also widespread. Yet the plastics industry says that its products are safe after decades of testing.

Environment

Most of the plastics we use today are made from petroleum or natural gas, non-renewable resources that is extracted and processed in such a way that requires a lot of energy and may harm ecosystems. The process of manufacturing plastic is a big contributor to air, land and water pollution. It also exposes its workers to toxic chemicals, including carcinogens. Plastic packaging, especially plastic bags, are crowding our landfills and the ocean. These plastics affect the soil where toxic chemicals are slowly released into the groundwater. It is also regularyly eaten by animals, injuring or poisining our wildlife, sometimes with fatal consequences. As plastic usage grows each year, it is evident that tackling this problem means adressing its sustainability.

>> continue on page 3

PET, PETE
(Polyethylene Terephthalate)

- Soft drinks, water and salad dressing bottles and peanut butter jars.
- Suitable to store cold or warm drinks. Bad idea for hot drinks.

HDPE
(High-density Polyethylene)

- Water pipes, milk, juice and water bottles, grocery bags, some shampoo/toiletry bottles.

PVC
(Polyvinyl Chloride)

- Not used for food packaging.
- Pipes, cables, furniture, clothes, toys.

LDPE
(Low-density Polyethylene)

- Frozen food bags, squeesable bottles, e.g. honey, mustard, cling film, flexible container lids.

PP
(Polypropylene)

- Reusable microwaveable ware, kitchenware, yogurt containers, microwaveable disposable take-away containers, disposable cups, plates.

PS
(Polystyrene)

- Egg cartons, disposable cups, plates, trays and cutlery, disposable take-away containers.

  Avoid for food storage!

Other
(often plycarbonate or ABS)

- Beverage bottles, baby milk bottles, compact discs, lenses including sunglasses, prescription glasses, automotive headlamps, riot shields, intrument panels.

What can you do to change your plastic habits?

• Bottled water: The plastics used to make the bottles for bottled water contains significant amounts of BPA and phthalates and the use thereof should rather be limited.

• Plastic shopping bags: This is really the easiest swap you can make. Keep reuseable shopping bags in your car/ handbag.

• Stainless steel and glass containers: Notice how many plastic containers are in your kitchen? The best step you can do to cut down on your plastic usage is to recycle it all and replace it with glass and stainless steel containers.

• If you do use plastic, never heat it: When plastic is heated, it leaches chemicals much faster. So never heat food in plastic containers or pour hot food into it. And those that specify 'microwave safe', it will still leach chemicals, it just won't warp in the heat.

• Buy fresh and/or frozen produce: BPA is present in the lining of most canned foods since it helps prevent food contamination. If possible, buy fresh and/or frozen food rather than the canned versions. Choose dried beans over canned beans. Buy fresh and/or frozen fruits and vegetables, or better yet, grow your own.

• Takeaway coffee cups: Did you know that although some takeaway coffee cups are not made from plastic, it is still lined with plastic on the inside. And then there is the BPA in the lid as well. Rather opt for a reuseable coffee cup that you can keep in your car.

• And lastly, RECYCLE: This should however not be an excuse to use plastic. But recycle whatever and whenever you can. You will be surprised by the impact it has on your household waste.

BACK TO BASICS

Rock types

There are many different rocks, some with long and difficult names. They can all however be classified under one of three fundamental rock types: igneous, sedimentary and metamorphic rocks.

Igneous rocks are typically associated with heat during formation. As explained by Gavin Whitfield in his very interesting book, *50 must-see geological sites in South Africa,* igneous rocks were the first to form on primordial Earth more than 4,000 million years ago. It forms when molten rock (magma) from deep within the Earth rises towards the surface. In some cases it slowly cools before reaching the surface and form so called *intrusions* classified as plutons (igneous rock bodies), dykes or sills (vertical or horisontal sheets). If the magma reaches the Earth's surface the very hot molten lava erupts into the atmosphere, cools very quickly and forms so called *extrusions*. Rocks from volcanic eruptions are examples of extrusions.

Typically a range of different minerals is formed depending on the chemical composition of the magma where these minerals will start to crystallise at different temperatures. Igneous rocks with high silica content are called 'felsic' (high in feldspar and quartz). The rocks with low to very low silica are called 'mafic' and 'ultramafic' and the rest 'intermediate'.

Gavin Whitfield further explains that the first **sedimentary rocks** were formed through the erosion of early igneous rocks, transport of detritus by streams and rivers and deposition of resulting sediment into the ocean. Thick deposits of sedimentary material then accumulated on continental shelves and in ocean basins.

There are three different classes of sedimentary rock that is formed: clastic, chemical and organic. These are classified primarily by grain size and mineral composition. Clastic sediments are by far more common than rocks of chemical (such as limestone and chert) and organic (such as coal and peat) origin. The grain size of a clastic sediment depends on the energy of the water that transported or reworked it.

Metamorphic rocks can be of either igneous or sedimentary origin. These rocks have typically been physically or chemically transformed under extreme conditions. According to Gavin Whitfield metamorphic rocks formed where large-scale crustal processes related to plate tectonics have involved the deep burial and compression of rock formations or where heat and pressure within the Earth's crust have radically changed the original rock formations. The metamorphic process takes different forms. It can either be transformed by being subjected to intense heat from an igneous intrusion (thermal or contact metamorphism), by being compressed by strong folding on a large scale (dynamic metamorphism) or by being buried deeply (burial or regional metamorphism).

PROCESS FOCUS

Reverse osmosis

Reverse osmosis is commonly used as a water purification method. It is in some areas the only means of availing safe drinking water to inhabitants. In other areas droughts are forcing people to consider alternative sources of potable water as dams are reaching record low levels.

The Huntington Beach facility in California reports on their website that there are currently operational desalination plants in more than 120 countries of which the Middle East currently has the highest number. Roughly half of the plants uses seawater as source and the rest uses brackish water.

Technically, it is not a difficult process, but the limitation of using it has mostly been economical. It has a high price tag because of the energy it requires. There has however been reports of significant cost saving innovations that are transforming this process into a more viable and sustainable alternative.

To understand how this process works, it is important to first understand what osmosis and osmotic pressure is.

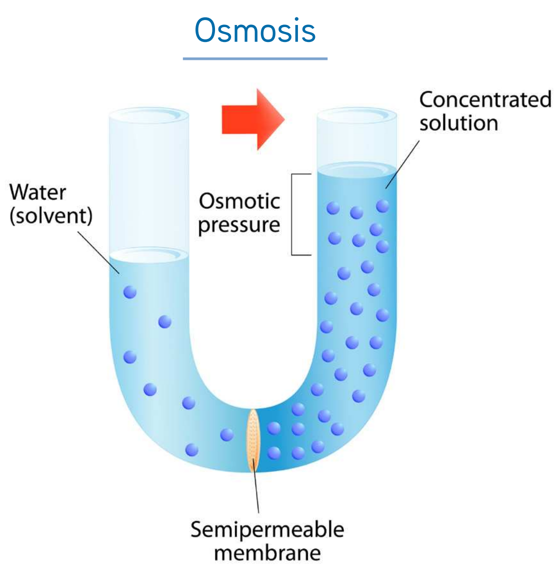
Osmosis can be described through the following example: If a U-shaped tube contains water in each side and has a water-permeable membrane separating the two sides then at the start the levels on both sides will be the same. When a solute like salt or sugar is added to the left side, water from the right side will permeate through the membrane to the left side. This process is called osmosis and serves to equalise the pressure from both sides on the membrane.

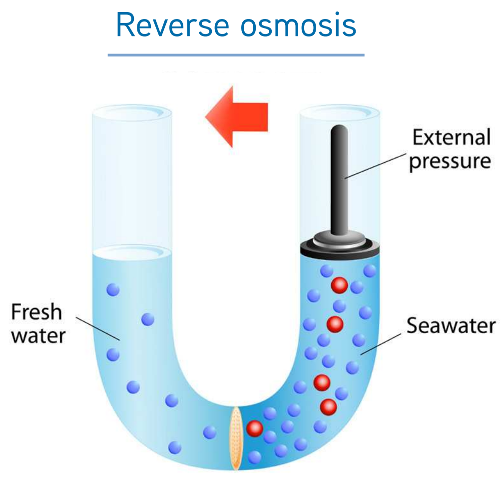
Osmotic pressure is the minimum pressure required to prevent the solvent from flowing through the membrane towards the side with higher concentration of solute. The osmotic pressure is directly proportional to the concentration of the solute(s).

During reverse osmosis, pressure is applied to the side with highest solute concentration to reverse the natural flow direction of the solvent through the membrane.

The desalination of seawater for human consumption is one of the best-known applications of reverse osmosis. During this process suspended solids such as ions, molecules and even bacteria are removed.

Other applications of reverse osmosis include the separation of sugary concentrate from water in the sap in the production of maple syrup as well as the concentration of whey and milk in the dairy industry.





BLUE CANVAS

Friendly faces on site

Karen Keet, the client support manager, recently visited some clients on site to discuss support related matters.

On the left is Phatsuthedzo Netshitangani from Pilanesberg Platinum.

On the right is Wilson Msendevu from Tharisa.

'Fedex day' challenge

Blue Cube Systems recently held an internal 24 hour challenge where employees had the opportunity to work on a self-identified project that would benefit the company. The reason for the challenge was that many employees have great ideas for improving their work environment, the products or the services of the company but there is not always time during normal working hours to investigate or test these ideas. The winner of the challenge was Pieter le Roux with his concept of using polyurethane instead of rubber lining for specific applications.

Client Support team workshop

The client support team held a two day workshop to brainstorm work flow improvements.

On the photo is Fernando Nieuwveldt, Phanus Bekker and Lize Cillie.

Blue Cube social

The Blue Cube team recently went to play Laser Tag for a social event. Pictured here are some of the Blue Cube employees ready to 'tag'.

Warm welcome

We welcome **Learnmore Moyo** to the Blue Cube team. He will be joining the engineering team where he will be mostly involved in commissioning of new installations but will also assist with repairs of existing installations.

BLUECUBE®
measurement for control