ChemE Herald

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From the Head's Office

It is with great pleasure that I present this inaugral issue of the Chemical Engineering Herald (ChemE Herald). This technical periodical newsletter is a departmental initiative to showcase and foster the growth and exposition of technical expertise.
— **Prof. S. K. Gupta**

Privatization of educational software

By: Rohit Goswami, Final ChemE

From process simulation techniques to NIST (SUPERTAPP) databases for chemical engineering data, there has been an inexorable march towards monetization and privatization of educational software. This is damning for aspiring chemical engineering students, as the software on which real predictions are based are being efficiently and quickly subsumed into various commercial software systems, like ASPEN and others. Even[1] states emphatically that the latest cost correlations and affiliated costing data are available via ASPEN only, and has not been published in open literature.

For a subject based on the sharing of industrial knowledge, with roots in the ACS (American Chemical Society) this is a grave state of affairs and is a strange irony. The most striking example of this wealth induced decline of academic resources is of course that of the erstwhile CHESS (Chemical Engineering Simulation System), developed by Dr. Rudy Motard and Dr. Ernest Henley at the University of Houston with a grant from the U.S. Navy. The developers of CHESS after gaining much academic merit chose to sell their rights to the software which has now become unavailable to students and is now marketed as CHEMCAD.

For the basic sciences there are still databases of freely available, robustly verified data, however, lest this miserable state of decline be noted and halted, our subject will decline away into nothingness. At this rate, the efforts of stalwarts such as Dryden, Sherwood, McCabe et. al who chose to disseminate their findings for the education of future generations will go in vain as there are none who carry forth their legacy.

This is not meant to be an invective piece on the relative merits of paid and open source software, however it must be noted with praise that the computer science discipline has never faced a slump by open sourcing their data and software tools. No company keeps secret in house programming languages, whereas in our industries, secrecy and stringent patent laws are the norm.

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Environment friendly fire extinguishers

By: Bhawani Shankar Tiwari, Third ChemE

The aim behind the development of new technology is for the production of novel, halogen-free, environmentally safe, highly efficient fire-extinguishing powders. It is based on local mineral raw materials and elaboration of new types of fire-protective materials. The basis of such fire-extinguishing powders are the composite materials which function as efficient flame retardant.

New technological developments are done which comprise of Micro Fog System and Low Frequency Sound which are more efficient and eco-safe than the traditional fire extinguishers. Fire extinguishing powders are prepared by grinding the raw materials followed by screening up to 250 micrometer dispersity, drying at 700-1000 degree Celsius and mixing of raw materials.

It does not require any additional chemical processing and modifications like expensive halogen containing hydrophobizing additives. Raw materials zeolite, clay shale and perlite are chosen due to their high performance properties and the ability to suppress the combustion and burning processes. They are of silicate origin, containing alkali and alkaline-earth metal carbonates, bicarbonates and iron, aluminium, alkali metal hydroxides. Therefore, at high temperatures these raw materials are characterized with emission of incombustible gases, steam and metal oxides which dilute combustible products, creating protective film and coke layer on the surface of material.

On the basis of thermogravimetric analysis it is stated that at the first stage adsorption and crystallization water separation takes place. At the next stage of higher temperature (700 degree celcius and more) there happens to be the formation of metal oxides protective film and coke layer. The liberated incombustible gases and water steam in the flame zone functions as phlegmatizer which leads to formation of swelled layer in surface zone. The protective film of metal oxides and coke layer cause a strong fire-limiting effect. This indicates the fact that these materials can exhibit the properties similar to highly effective homogeneous inhibitors.

Powder enchancing equipment

A. Fire Extinguishing Balls

Several modern ball or grenade-style extinguishers are available in the market. They are manually operated by rolling or throwing into the fire. In modern version, the ball will explode once it comes in contact with the flame, dispersing a cloud of ABC dry chemical powder over the fire which extinguishes the flame. The coverage area is about 5 m^2 (54 sq. ft.).The benefit of this method is that it may be used for passive suppression. The ball can be placed in a fire prone area and will deploy automatically if a fire develops. Most modern extinguishers of this type are designed to make a loud noise upon deployment.

B. Condensed Aerosol Fire Suppression

Condensed aerosol fire suppression is a particle-based form of fire extinction similar to gaseous fire suppression or dry chemical fire extinction. As in the case of gaseous fire suppressants, condensed aerosol suppressants also use clean agents to suppress fire. The agent can be delivered by means of mechanical operation, electric operation, or combined electro-mechanical operation. The difference between gaseous suppressants and dry chemical extinguisher is that the former emits only gas, while the later release powder-like particles of a large size (25-150 micrometer).The condensed aerosols are defined by the National Fire Protection Association as they release finely divided solid particles (generally $<$10 micrometer) in addition to gas. The dry chemical systems must be directly aimed at the flame. The condensed aerosols are flooding agents and therefore are effective regardless of the location and height of the fire.

Other Innovative Fire Extinguishers

Water Mist Systems (Micro Fog)

It converts liquid water to uniform fine water mist (50 to 200 micro m). It is a new fire extinguishing system which is clean and has enhanced fire extinguish-

ing capability, marked by both high cooling capability of sprinkler system and excellent fire extinguishing capability of gas type fire extinguishing system. It suppresses fire with less water discharge even for those objects for which the conventional water-based fire extinguishing equipment is not viable considering performance and economy.

Low Frequency Sound

The basic concept behind this technology is the displacement of air by sound waves. Sound waves (pressure waves) displaces oxygen as they travel through the air. By producing sound of 30 to 60 Hz we can deprive oxygen from the space which inhibits the growth of fire. This technology is free from chemical and water and offers a relatively non-destructive method of fire control, which could find applications in fighting home and small scale fire.

Water harvesting via desalination

By: Shantanu Mall, Third Mechanical

Less than 3% of the Earth's water is fresh, with most of it trapped underground or in ice and glaciers. That only leaves less than 1% accessible for drinking and supporting life as we know it. Fresh water is finite yet we continue to waste it not knowing that we are dooming ourselves to a catastrophic crisis. There is an urgent need of new water harvesting methods and desalination is one of the most prominent method being used.

Desalination is a process that extracts mineral components from saline water. Saltwater is desalinated to produce water suitable for human consumption or irrigation. Feed water sources may include brackish, seawater, wells, surface (rivers and streams), wastewater, and industrial feed and process waters. Seawater desalination has the potential to reliably produce enough potable water to support large populations located near the coast.

The problem is that the desalination of water requires a lot of energy. Salt dissolves very easily in water, forming strong chemical bonds, and those bonds are difficult to break. The International Desalination Association says that there are about 19,000 desalination plants operating around the world. They pumped out approximately 14.7 billion gallons (55.6 billion liters) of drinkable freshwater a day. A lot of these plants are in countries like Saudi Arabia, where energy from oil is cheap but water is scarce.

Desalination Processes

The two basic methods for the desalination of seawater from a chemical engineering perspective are:

Thermal Distillation and Membrane separation
Thermal distillation involves heating and Boiling water turns it into vapour leaving the salt behind that is collected and condensed back into water by cooling it down.

Reverse Osmosis
The leading process for desalination in terms of installed capacity and yearly growth is reverse osmosis (RO). The RO membrane processes use semipermeable membranes and applied pressure (on the membrane feed side) to preferentially induce water permeation through the membrane while rejecting salts. Reverse osmosis plant membrane systems typically use less energy than thermal desalination processes. Water shoots into the cylinders at a pressure of 70 atmospheres and is pushed through the membranes, while the remaining brine is returned to the sea.

Desalination processes are driven by either thermal (e.g., distillation) or electrical (e.g., RO) as the primary energy types. Energy cost in desalination processes varies considerably depending on water salinity, plant size and process type. RO membranes do not have distinct pores that traverse the membrane and lie at one extreme of commercially available membranes. The polymer material of RO membranes forms a layered, web-like structure, and water must follow a tortuous pathway through the membrane to reach the permeate side. RO membranes can reject the smallest contaminants, monovalent ions, while other membranes, including nanofiltration (NF), ultrafiltration (UF), and micro-filtration (MF), are de-

signed to remove materials of increasing size.

Case Study: Israel

Israel has proven itself as a world leader in desalination after decades of research and entrepreneurship. The new plant in Israel, called Sorek, was finished in late 2013 but is just now ramping up to its full capacity; it will produce 627,000 cubic meters of water daily, providing evidence that such large desalination facilities are practical. Indeed, desalinated seawater is now a mainstay of the Israeli water supply. Whereas in 2004 the country relied entirely on groundwater and rain, it now has four seawater desalination plants running; Sorek is the largest. Those plants account for 40 percent of Israel's water supply. Israel now gets 55 percent of its domestic water from desalination, and that has helped to turn one of the world's driest countries into the unlikeliest of water giants. Desalination is seen by some as a magic bullet, the shield that saved Israel from the whims of nature.

Need of the hour- Despite the economic and environmental hurdles, desalination is becoming increasingly attractive as we run out of water from other sources. We are overpumping groundwater, we have already built more dams than we can afford economically and environmentally, and we have tapped nearly all of the accessible rivers.

The world faces an unprecedented crisis in water resources management, with profound implications for global food security, protection of human health, and maintenance of all ecosystems on Earth. Large uncertainties still plague quantitative assessments of climate change impacts and water resource management Fortunately, the human race has a reputation for having the irrepressible ability to adapt in times of great adversity by rising to meet great challenges. We need to realise that it is not too late to make the necessary changes and that even in our own personal capacity, we have the ability to change the world.

"Save Water, Save Life" — Anonymous