The Filtration Society Addresses Environmental Issues

Dr Graham Rideal, Whitehouse Scientific Ltd

It is surprising how often filtration and separation is perceived as a minority subject buried within mainstream disciplines such as Physics, Chemistry or Chemical Engineering. However there are very few areas where filtration does not play an active role. We only have to look in our kitchen to find filters for water, tea, coffee, extractor fans, air conditioning, clothes and dishwashers and even colanders for straining rice for example.

On a larger industrial scale too, filters and separators are the most common plant in any process involving solids, whether the commodity in question is the solid or liquid phase.

Of all the international seminars organised by The Filtration Society, the most well attended invariably cover filter testing, optimising filter efficiency/profitability and the importance of filtration in protecting the environment. All the aforementioned subjects are of course related. Industry can no longer dump waste into the environment, whether it be to atmosphere, water courses or landfill.

A major thrust by The Filtration Society over the past two years has therefore been to highlight the latest environmental legislation and review the relevant problem solving technologies.

> ***ONE OF OUR OBJECTIVES IS TO FACILITATE AND ACCELERATE THE DEVELOPMENT OF FILTRATION AND SEPARATION TECHNOLOGIES TO IMPROVE THE EFFICIENCY OF INDUSTRY AND THEREBY IMPROVE THE QUALITY OF THE ENVIRONMENT***

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PURE WATER

Pure water is, and has been since time begun, the most important natural resource to man. Without pure drinking water the speed of industrial progress would have been severely restricted, simply because the large concentration of workers required to power the technological developments would have been decimated by water borne diseases.

As a direct result of improvements in filtration processes, Membrane Bioreactors are now replacing conventional water treatment plants. Having a footprint a tenth the size enables the plants to be installed in almost any location, even within cities where land is at a premium.

Rivers that used to be streams of dilute acid and toxic effluent in the times of the Industrial Revolution are now so clean that a healthy stock of fish has returned.

TURNING WASTE INTO THE PRIMARY PRODUCT

It is very interesting that the solutions to a clean environment do not always incur a cost penalty. Take for example the cheese industry. Since its inception cheese was always the primary product with whey the by-product, which increasingly became the waste product simply discharged into rivers. Once such a practice was outlawed, the industry was forced into reconsidering the disposal of the whey. Incineration was too expensive so novel applications were sought. The result was that, by using the latest ultrafiltration units, the whey could be concentrated and used as the precursor for yogurts and the latest prebiotic drinks. Paradoxically, in terms of profitability, the cheese has now become the by-product.

DIAMONDS ARE FOREVER

In another interesting example, waste carbon from the production of industrial diamonds was stored in steel drums, just in case any residual fine diamond could be recovered. After many years of storage the drums corroded and started to leak into a nearby river. The manufacturer was then forced to dispose of the residue. Surprisingly, road construction was the preferred option (a literal interpretation of the Paul Simon song 'Diamonds on the soles of your shoes'!). The disposal had just commenced when a new centrifugal density separation and filtration process was applied, more commonly found in the Cornish tin mines. The new technology recovered 1.5% as diamond worth millions while the carbon could be recycled in the process.

Figure 1. A high efficiency ultrafiltration system (Courtesy of GEA Process Engineering)

FLUE GAS CLEANING

Of course, it is not always possible to make a profit out of waste. The focus of filtration and separation technology is then one of process optimisation for improved efficiency, reduced environmental impact or simply improving profitability. So-called 'end of pipe' solutions are invariably only a partial solution and the biggest cost savings come from fully integrated technologies.

One exception to the rule is the latest developments in flue gas cleaning. Using high temperature ceramic fibres, incineration gases no longer have to be cooled before filtration. Not only can toxic particulates be efficiently removed but, by using chemically specific catalysts and chelating agents at the high temperatures, oxides of nitrogen, sulphur and toxic heavy metal vapours can also be removed before discharging to the atmosphere.

ACID RAIN

In terms of environmental destruction, few industries come even remotely close to the early coal fired power stations. Drax and Ratcliffe-on-Soar power stations alone are capable of burning a total of 55,000 tons of coal a day. In the seventies and eighties, this was mostly British coal with a high sulphur content. Without any flue gas desulphurisation, the sulphur dioxide combined with water in the atmosphere to produce thousands of tons of sulphuric acid, which precipitated onto some unfortunate country down wind.

Flue gas desulphurisation plants have since been fitted at a combined cost of 1 billion dollars. This has resulted in sulphur dioxide reductions of 92% and is on target to reach 98% in the next two years.

QUALITY BY-PRODUCTS

Not only has toxic discharge to the atmosphere been virtually eliminated, but the power stations actually contribute to the cleaning up of rivers. This is because they are forced to take any water that comes from upstream, irrespective of quality. It may be high in dissolved metals or particulates from heavy rain for example, and so has to be filtered and purified before it is used in the cooling towers. It is not sufficient to discharge the water at the quality received and so it is invariably returned to the river at a much higher quality.

In addition to pure water, plasterboard (the calcium sulphate produced from reacting the sulphur dioxide with Gypsum) and building blocks made from the ash residue are important by-products that at one time were high consumers of energy in separate industries.

It is only to be hoped that the Chinese coal fired power stations, currently being built at the rate of two a week are adopting the same concern for the environment!

CARBON FOOTPRINTS

The subject of power generation these days cannot be left without addressing the issue of global warming through CO_2 emissions. It is a frightening statistic that the Drax power station alone produces three quarters of a ton of CO_2 every second! Multiply that by the number of coal fired power stations in the world and we can see the magnitude of the problem facing our environment in the future.

Figure 2. The EON Ratcliffe-on-Soare coal powered power station is on target to remove 98% of the sulphur dioxide from its flue gas.

Although there are filtration technologies capable of filtering out CO_2 from other gases, the shear scale of the problem defeats current technology. And if it were attainable, what do we do with the concentrated gas?

One solution being talked about in the UK is to store the greenhouse gases under the North Sea in exhausted oilfields. Grants in excess of 2 billion dollars of taxpayer money are being proposed and the major power producers are already submitting proposals.

But this can only ever be a temporary solution to countries with depleted oil fields with caverns big enough to contain the projected volumes of CO_2. Furthermore, the possibility of leaks through diffusion or geological disturbances can never be ruled out.

There is no doubt therefore that the use of fossil fuels for power generation has a finite life span and there is a sensitive balance between power generation and the survival of the planet.

PROCESS EFFICIENCY

One of the objectives of The Filtration Society is to facilitate and accelerate the development of filtration and separation technologies to improve the efficiency of industry and thereby improve the quality of the environment.

The next two international seminars will investigate methods of optimising process efficiency to save energy and thereby improve profits. The first will address automation in filter processes while the second will discuss the impact of latest filtration media on process efficiency.

ABOUT THE FILTRATION SOCIETY

The Filtration Society was formed over 40 years ago to focus the then disparate subject of filtration and separation into one mainstream discipline.

Up to that point the subject had been somewhat diffused within Chemistry, Chemical Engineering, Physics and Pharmaceuticals to name but a few. The objective was to disseminate, collate and advance the science through an independent, not-for-profit organisation.

The Filtration Society's highly acclaimed journal FILTRATION is now distributed in over 30 countries and is increasingly looked upon by industry and academia alike as an invaluable resource for state-of-the-art developments.

One of the principle vehicles for the promotion of new technology is a series of symposia where the latest technologies are discussed. **www.filtsoc.com**

Really Tough: Outdoor Electrodes for pH, Cond., O2

Hach Lange's portable HQD metres and Intellical electrodes measure the classic electrochemical parameters pH, conductivity and dissolved oxygen, using the drift-free optical method LDO.

What makes HQD special is the newly developed Intellical sensors: They store all relevant parameters and transmit them digitally to the meter.

Thus making them safe from interferences and allowing for cable lengths up to 30 m – even for pH! Previously inaccessible measurement locations e.g. boreholes and bridges are now within reach. No need to draw a sample first.

The waterproof outdoor electrodes (IP67) have a hull made from stainless steel and are suitable for the toughest challenge. Their weight prevents them from drifting on the surface in strong currents. The impact protection of the sensor head can be removed for cleaning purposes.

HQD is available as a complete set with electrodes in a rugged field kit case. Additionally there is a wide range of buffer and standard solutions to choose from, plus further practical accessories.

Circle no. 87

The Determination of Mercury in Sediments, Soils and Sludge

Teledyne Leeman Labs announce the release of a new application note for the Determination of Mercury in Sediments, Soils and Sludge using the Hydra-C Mercury Analyser.

Now in their third generation, the Hydra Series of products cover a range of techniques including cold vapour atomic absorption, cold vapour atomic fluorescence and automated sample preparation. The Hydra-C extends the capabilities of the Hydra Series by permitting the direct analysis of solid samples by combustion.

The accurate determination of mercury in sediments and sludges is important for the proper and safe disposition of these materials. Teledyne Leeman Labs' Hydra-C Direct Mercury Analyser provides fast, simple and convenient analyses of these materials without sample pretreatment or production of hazardous chemical waste.

A typical sample analysis takes about 5 minutes. The Hydra C is designed to address the needs of analysts that want to use EPA's new method 7473 or that simply want to determine mercury without prior sample digestion.

Circle no. 88

Project Aims to Reduce Water Risk in Europe

An EU project costing an estimated €2.5M will aim to provide vital timely information for the management of pollution incidents in coastal areas and large rivers. Ian Thompson from project partner YSI Hydrodata says "The project will develop novel water quality monitoring techniques and exploit recent developments in communications technology to produce a network of monitoring stations that will integrate with satellite based remote sensing equipment to provide a real-time monitoring network for diffuse and point source pollution. As a result it will be possible, for example, to monitor chemical leaks and spills and predict the growth of algal blooms."

The EU Water Framework Directive has stimulated a demand for greater monitoring data. It is now necessary to take measurements at more points, more often. However, water sampling and subsequent laboratory analysis is time consuming and costly. Furthermore, sampling frequency has to be high in order to ensure that all water quality events are detected. This has created a need for continuous monitoring systems that are able to provide real-time data.

WARMER (WAter Risk Management in EuRope) is a research project funded by the EC 6th Framework Programme, under the IST-Environmental Risk Management program aiming to fulfil the growing demands for real-time monitoring data.

The water quality monitoring system being developed within 0automated in-situ probes capable of making a variety of measurements including temperature, conductivity, ammonium, nitrate, phosphate, pH, redox, calcium, chloride, dissolved oxygen, lead, cadmium, copper, turbidity, colour, mercury, iron, chromium, phenols, chlorophyll/phyto pigments in addition to water direction and flow.

Several of these parameters are measured by existing technologies within the YSI multiparameter sondes; however, a range of subsidiary development projects will seek to develop technologies for the remainder.

Circle no. 89