June 2016

CHEMICAL ENGINEERING

ESSENTIALS FOR THE CPI PROFESSIONAL

www.chemengonline.com

Practical Troubleshooting

Vortex Breakers

Predicting Prandtl Numbers

Facts at Your Fingertips: Petrochemical Industry Reactions

Focus on Sensors and Detectors

Shedding Light on Rupture Discs

page 38

Electropositive Filtration

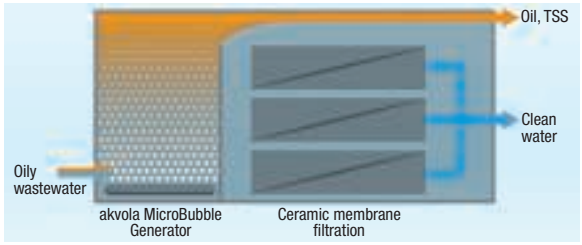
Innovation in the Glass Industry

Heat Transfer Equipment

Access Intelligence

Commercial launch for a hybrid wastewater-treatment process

A hybrid process that combines micro-flotation and flat-sheet ceramic-membrane filtration to remove oil and suspended solids from difficult-to-treat industrial wastewater has been commercialized by akvola Technologies (Berlin, Germany; www.akvola.com). The system can treat water with high oil loads (up to 3 wt.%) with up to 99% removal efficiency, and at a fraction of the costs of alternative technologies, says Lucas León, founder and CFO.



In the akvoFloat process (diagram), wastewater is continually fed to the microflotation zone, where the akvola MicroBubble Generator induces fine (50–100 µm) gas bubbles. The small bubbles have a large surface-to-volume ratio, and agglomerate with suspended solids, oil, grease, algae and organic flocs to form a float layer, which is skimmed from the tank. The water then passes through the membrane module, which contains dead-end-operated, flat-sheet ceramic membranes. The akvoFloat systems are engineered to achieve stable operation at very high fluxes — generally five times higher than that of polymeric membranes, says León.

Operation at higher flux enables a reduction in the membrane area required, which translates into lower investment costs, explains León. Operating the membrane dead-end also reduces energy costs, because the pressure drop (transmembrane pressure of 0.2 bar) is 7–10 times lower than that used in crossflow membrane systems, he says. Finally, the MicroBubble Generator consumes 5–10 times less energy than conventional dissolved air flotation (DAF) systems.

The process was first demonstrated in a 400-m^3/h pilot plant that treated scrubber water at a metallurgical-coke plant of ThyssenKrupp in Duisburg, Germany. The company is now focussing on treating oily industrial wastewaters, such as that generated in the metalworking, petroleum-refining and steel industries. In the first quarter of 2016, akvola Technologies has received six orders for its akvoFloat units, the first of which (2.5 m^3/h) has been operating since March at a wastewater treatment facility in Austria. The company is also working on the engineering of larger scale projects (250 m^3/h) with two EPC (engineering, procurement, construction) companies for two different applications, says León.

Sun and rain generate electricity in this solar cell

An all-weather solar cell that generates electricity by both sunlight and rain has been developed by researchers led by professor Qunwei Tang from the Institute of Material Science and Engineering at Ocean University of China (Qingdao; http://eweb.ouc.edu.cn) and professor Peizhi Yang from Yunnan Normal University (Kunming, China; www.csc.edu.cn).

The researchers developed a highly efficient dye-sensitized solar cell and coated the cell with an extremely thin film of graphene. Graphene conducts electricity and has a large number of electrons that can move freely across the entire graphene layer (delocalized electrons). In aqueous solution, graphene can bind positively charged ions with its electrons, a property used to remove lead ions and organic dyes from solutions.

This property inspired the researchers to use graphene electrodes to obtain power from the impact of raindrops. The raindrops contain salts that dissociate into positively and negatively charged ions. The positively charged ions, including sodium, calcium and ammonium ions, can bind to the graphene surface. At the point of contact between the raindrop and the graphene, the water acquires additional positive ions and the graphene acquires additional delocalized electrons. This forms a "pseudocapacitor" made of a double-layer of electrons and positive ions. This produces a voltage and current.

Tang says the all-weather solar cell will make it possible to generate electricity also in acid-rain-prone areas and on islands and reefs. It can also be used in marine navigation, he says.

Edited by:
Gerald Ondrey

COOLING-TOWER MOTOR

A new electric motor for driving cooling-tower fans features a design that prevents current from flowing through the shaft bearings, allowing longer lifetime and less maintenance. The TEAO motor, made by Marathon Motors Corp. (Wausau, Wis.; www.marathonelectric.com) also has the highest ingress protection (IP) rating for small airborne particles of any fan motor currently available and can be mounted with the shaft at any angle, the company says. It is suitable for use in all HVAC (heating, ventilation and air conditioning) applications and for cooling towers in the power generation and other industries, notes Chris Voll, distribution product manager at Marathon. The motor is available in a range of sizes from 3 to 250 hp.

ELECTRODE SLURRY

A continuous process for making electrode slurry for lithium-ion batteries has been developed by Bühler AG (Uzwil, Switzerland; www.) and Chinese battery producer Lishen, enabling this critical material to be manufactured on a larger scale to meet the increasing demand for electric-powered vehicles. The new process uses a twin-screw extruder to make the slurry, which formerly had to be made batch-wise. The new process enables a "much more consistent quality to be achieved, takes up 60% less space and reduces energy consumption by 60%," compared to batch production, says Bühler.

Lishen awarded Bühler its first large-scale order for four production lines valued at nearly CHF10 million (about $10.2 million). The investment represents a production capacity of about

(Continues on p. 8)

Note: For more information, circle the 56-digit number on p. 74, or use the website designation.