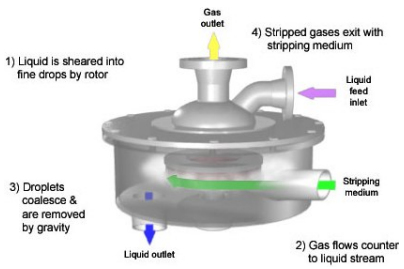
NEW TECHNOLOGY SCOUTING REPORT
Q2/2011-Q3/2012

1. High-Gravity technology for industrial water treatment.

Gas Tran Systems (Cleveland, OH) offer HiGee-based intensified technologies for improving mass transfer in water treatment, e.g. solutions for water deaeration in beverages bottling. Other application areas include: decarbonation systems for deionized water, separation and recovery in process streams, deaerators for enhanced oil recovery using waterflood, deaerators for boiler feedwater and degasifiers for aquifer storage recovery. The basis for all systems are Rotating Packed Beds developed at Case Western Reserve University (Prof. Gardner).

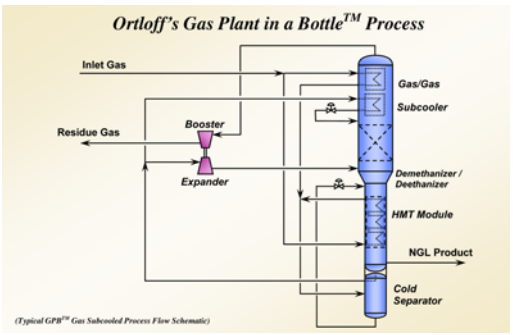


www.gastransfer.com

2. Highly integrated unit for NGL/LPG recovery.

Ortloff Engineers, Ltd. developed a highly integrated unit for NGL/LPG recovery.

The primary feature of this proprietary “Gas-Plant-in-a-Bottle” technology is the integration of the heat exchange and mass transfer into a single heat and mass transfer (HMT) module within the Demethanizer or Deethanizer. This HMT module replaces the trays or packing in the traditional stripping section, while also eliminating external side / bottom reboilers and their associated piping. Another feature of the GPBTM is the ability to locate the residue gas heat exchangers within the assembly, thereby eliminating residue gas piping and reducing residue gas pressure drop.



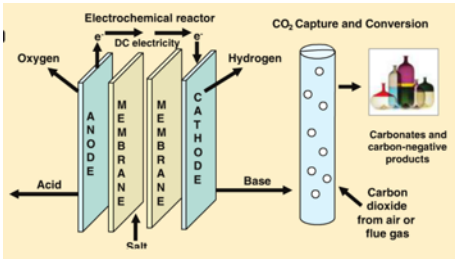
www.ortloff.com

3. New technology to covert wastewater and CO_2 into chemicals.

New Sky Energy (Boulder, CO) developed an electrochemical and chemical precipitation technology that allows the conversion of salty wastewater and CO2 from fluegas into valuable chemicals.

The New Sky scheme includes a proprietary electrochemical reactor in which Nafion ion-exchange membranes are stacked between alternating anode and cathode plates, and a small voltage (3 V) is applied across the cell. The process generates a suite of potentially useful chemicals, including carbonates, hydroxides, hydrochloric and sulfuric acids, sodium chloride, sodium sulfate and others.

The company has built two large prototypes and plans a pilot facility by the end of 2012, and a 3-4 ton/d modular production facility at client site by the middle of 2013.



The Chemical Engineering, June 2012

4. A compact thermal storage system.

Researchers from the Fraunhoffer Institute for Interfacial Engineering and Biotechnology (Stuttgart) and ZeoSys GmbH (Berlin) are developing a new thermal storage system that can store 3-4 times the amout of heat as water, and can even operate at temperatures exceeding 100oC. The system uses zeolite pellets that capture or release heat, depending on demand. A 750 L test facility is being tested.

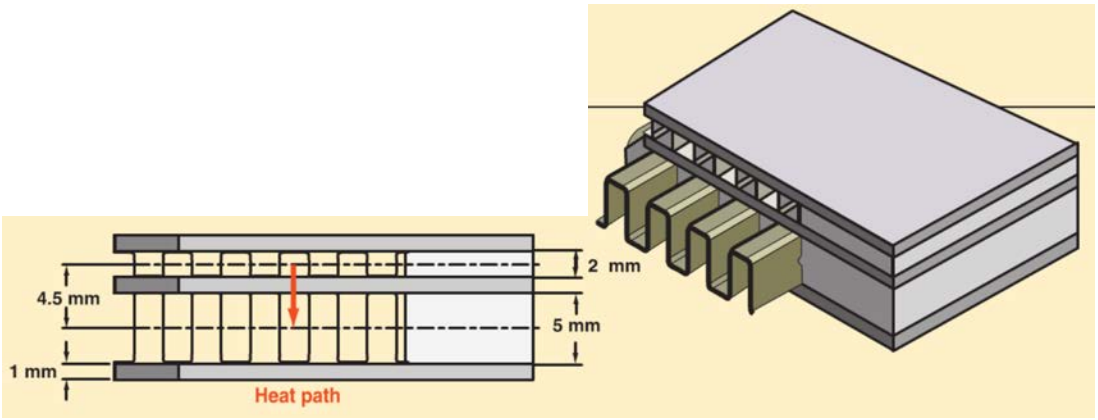
The Chemical Engineering, July 2012.

5. Novel Fischer-Tropsch reactor with more efficient heat removal.

Chart Energy and Chemicals Inc. (La Crosse, Wisc.) is developing a new compact heat exchange reactor (CHER) for the Fischer-Tropsch synthesis, that is said to solve the heat removal problem and could theoretically achieve a close to 100% conversion.

CHER is a plate-and-fin structure comprised of process layers of narrow channels (under 10 mm), sandwiched between coolant layers. Syngas flows over a cobalt catalyst in the channels and a conventional hot oil-based coolant passes through the coolant layers. According to Chart, the heat exchange in the device is s intensified that there is no need to dilute the gas or the catalyst.

Chart has done pilot tests and is currently working up to a 100-bbl/d unit. Because of the smaller size, the company expects the capital and operating costs roughly 50% below those of conventional plants.

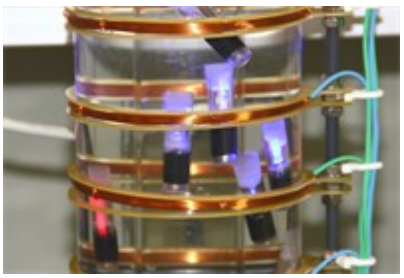


The Chemical Engineering, August, 2012

6. Floating LEDs photoreactor for water treatment.

Researchers from Wetsus institute (Leeuwarden, The Netherlands) developed a new type of photoreactor for disinfection of wastewater in hospitals. The so-called “Fluid-Bed Induction Reactor” utilizes small LED lamps that float free in the reactor volume. The energy transfer to the LEDs takes placed wireless, via induction.

The reactor is currenty being tested in the demonstration facility of Antonius hospital in Sneek.



Technisch Weekblad, 6 october 2012

7. Nonthermal pulsed electric field for milk pasteurization.

Diversified Technologies, Inc. (Bedford, MA) developed a new technology for pasteurization of milk, as alternative to heat pasteurization. The technology, utilizing pulsed electric field (PEF) is also suitable for juices, yogurt and other foods that can be pumped. The PEF system does not alter the flavor or consistency of the foods or liquids, the company says. The custom-engineered PEF system employs brief pulses of very high voltage, and can process between 50 and 10,000 L/h. The company claims that its PEF system achieves a greater than 5-log bacteria kill and uses less energy than conventional pasteurization technologies because operators have full control over pulse and frequency.

http://www.foodprocessing.com/articles/2011/pasteurization.html?page=print

8. Using microwaves to produce chemicals from citrus peels.

Citrus peel, coffee waste, pea pods and cashew shells could provide an untapped carbon source for producing commercially viable, higher value chemicals and materials, according to scientists at the University of York. They have developed the Biowaste Industrial Symbiosis Network to convert food waste -- including cashew shells, citrus peels and coffee grounds -- to valuable chemicals. Technologies used include low temperature microwave processing and supercritical carbon dioxide extraction (both food-compatible) to extract valuable chemicals such as pectin, limonene, fatty acids, aromatic compounds, etc.

http://www.foodproductiondaily.com/Processing/Scientists-squeeze-value-from-citrus-peel?utm_source=copyright&utm_medium=OnSite&utm_campaign=copyright

9. Microchannel biomass-to-liquids technology selected for jet fuel project

Microchannel Fischer-Tropsch (FT) technology developed by the Oxford Catalysts Group (Abingdon, U.K.; www.oxfordcatalysts.com) has been selected for use in a biomass-to-liquids (BTL) project under development in the U.K. by the U.S.-based company, Solena Fuels Corp. (Washington, D.C.; www.solenafuels.com). Solena was advised by Fluor Corp. on its choice of technology. The fuels produced via BTL can be used in existing engines and infrastructure.

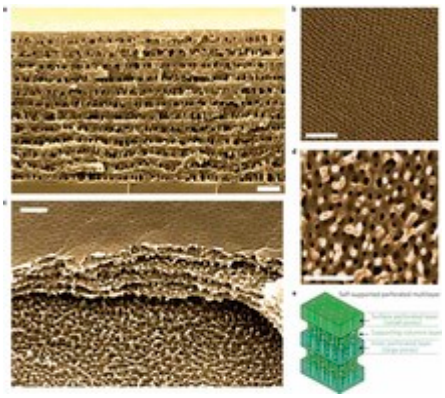
The project, known as GreenSky London, will convert waste biomass into sustainable jet fuel, and aims to become Europe's first commercial-scale sustainable jet fuel facility. The leading partner in the project is British Airways, which intends to use the low-carbon fuel to power part of its fleet by 2015. In addition, Solena has entered into an understanding with the Oxford Catalysts Group to supply microchannel FT units for Solena's future BTL projects with airlines and shipping companies. These projects include GreenSky California, GreenSky Rome and Greensky Stockholm.

http://www.che.com/nl/YToyOntpOjA7czo0OiI5NDgwIjtpOjE7czoyMzoib25seV9vbl9jaGUvbGF0ZXN0X25ld3MiO30=/

10. New nanoporous materials via collective osmotic shock.

Researchers from the University of Cambridge have deleoped a procfess for making nanoporous materials that they say is more flexible and effective than current techniques. Most nanomaterials are made by removing one component of a multicomponent material, which leaves behind a network of nanoscale pores. In current methods this component needs to be connected via the porous structure to the outside, in order for it to be removed.

The new technique uses collective osmotic shock to remove one component from the material. Soft materials permeable to solvents — such as cells or vesicles — can rupture as a result of stress build-up stemming from an imbalance in osmotic pressure. Such an osmotic burst has now been multiplied in a coordinated fashion within ordered materials. The approach leads to orderly nanoperforated materials that may find applications in photonics, optoelectronics and nanofiltration. To prepare a material for such 'collective osmotic shock', Cambridge researchers used self-assembled block-copolymer films consisting of close-packed layers of polymethyl methacrylate (PMMA) globules within a polystyrene matrix. They then broke the globular PMMA down into oligomers using ultraviolet light, and immersed the films in acetic acid — a solvent suitable for the oligomers. As the solvent permeated through the film layer by layer, it swelled the oligomer globules, causing them to deform and rupture in concert. The researchers claim that such a collective osmotic rupture produces periodic nanoporosity within any ordered material containing a minority component that can be selectively degraded and solvated within a deformable matrix. The team demonstrated that these perforated structures behave as one-dimensional photonic crystals, and that they can be used as ultrafiltration membranes and as electrodes in light emitting devices.



http://www.natureasia.com/en/research/highlight/6103

11. Highly selective CO_2 adsorption on zeolite

A team of researchers from the National Institute of Standards and Technology (NIST) and the University of Delaware demonstrated the applicability of the SSZ-13 zeolite to the selective adsorption of carbon dioxide. Current methods for capturing CO_2 involve its absorption in alkanolamine solutions and are energy expensive. It has now been shown that a previously discovered (Chevron 1985) - SSZ-13 – is highly discriminating when t comes to gas adsorption, preferring CO_2 over other molecules. According to NIST researchers a zeolite like SSZ-13 probably will become a prime candidate for carbon scrubbing because it also could prove more economical than other scrubbers currently used in industry. SSZ-13's ability to attract only CO_2 could

mean its use would reduce the energy demands of scrubbing, which can require up to 25 percent of the power generated in a coal or natural gas power plant.

Chemical Engineering Progress, April 2012.

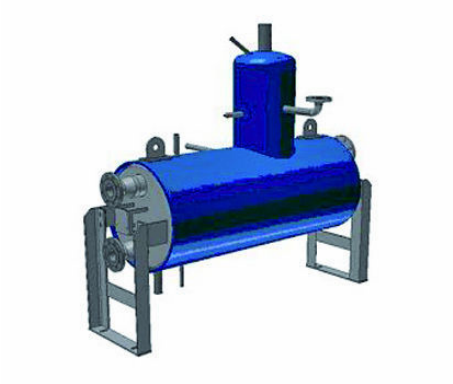
12. New metal-organic framework cuts out separation process.

Scientists at the University of Berkeley developed a new iron-based metal-organic framework (MOF), which may allow removing the cryogenic distillation (-100^{o}C) step in hydrocarbon processing. The new material, called Fe-MOF-74 enables a selective binding of olefins to iron, while saturated hydrocarbons flow through unimpeded. According to the researchers, the new MOF was able to deliver at least 99% pure ethane, while in case of propane the impurities were undetectable. The process operates at temperature of 45^{o}C. If applied on industrial scale, this new adsorption technology could eliminate the energy-intensive cooling step in the current distillation process.

The Chemical Engineer, 13 April 2012

13. Multifunctional plate-and-shell heat exchangers.

In the past, shell-and-tube heat exchangers were the preferred choice for applications involving high pressures, temperatures, or both. More recently however, plate-and-shell exchangers proved themselves suited to pressures up to 150 bar and temperatures up to 400 °C. Plate-and-shell exchangers combine the pressure and temperature capabilities of a cylindrical shell with the excellent heat transfer performance of a plate heat exchanger. The round plates ensure an even distribution of mechanical loads, without the stress concentrations that occur in the corners of rectangular plates. he plate-and-shell design is as versatile as it is strong and thermally efficient. Just like a shell-and-tube exchanger, the cylindrical shell can be equipped with nozzles for filling, draining, venting, pressure measurement and so on. When the exchanger is used as an evaporator, the plate package can be positioned eccentrically in a large shell to reduce pressure drop. Classic kettle-type evaporators can thus be equipped with a plate pack instead of a tube bundle.



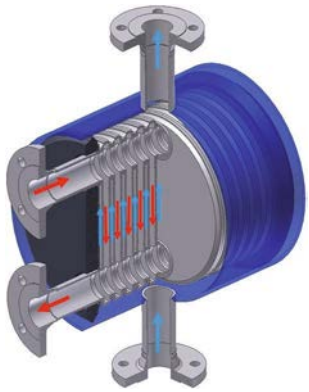


Plate-and-shell heat exchangers are mainly designed for a specific purpose such as heating, cooling, evaporation or condensation.

Combined tasks often require different equipment types, which are then executed with several and each other interconnected devices. The German manufacturer Gesmex has developed a concept with different devices combined in one unit. In this two plate packages with different corrugations are built into one shell:

- One plate pack works as a pre-heater of the liquid phase.
- A second package consists of plates with larger channel cross-sections and is optimized for the vaporization of the preheated medium.
- The plate packages are operated with one or more heating circuits via multiple connections.

The compactness of this unit increases once more by an integrated degasser with demistor to dehumidify the generated steam. Various measurement, inspection, discharge and vent connections complete the functionality of the plate heat exchanger. The result is a heat transfer system based on the so called Plate & Shell technology which is so compact as well as weight-optimized that it can be used in flexible systems like mobile Organic Rankine Cycle plants for decentralized power generation. In realized plants, the space requirements have been reduced by more than 30 percent and the weight by more than 15 percent, the company says.

http://www.process-worldwide.com/engineering_construction/vessels_apparatuses/heat_exchanger/articles/367972/index2.html
http://www.process-worldwide.com/engineering_construction/vessels_apparatuses/heat_exchanger/articles/307654/

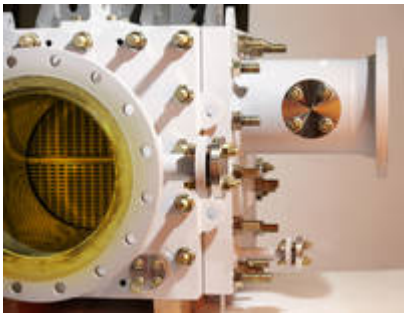
14. New heat exchangers for high-viscosity media and media loaded with solids.

GEA Heat Exchangers presented its new welded GEABloc series with Double Dimple pattern at the ACHEMA – Efficient plate heat exchangers for media loaded with solids.
The GEABloc is a welded high-performance plate heat exchanger designed for extreme pressure and temperature ranges. These units feature high heat recovery rates, extremely low space requirements and a clearly lower price compared to conventional shell-and-tube heat exchangers. The “Double Dimple” plate design guarantees free flow particularly for high-viscosity media with simultaneous low

pressure loss when used as condenser in the vacuum range and reduces operating costs in the long term.

The free flow gap in the plate design ensures blockage-free operation with solids-loaded media. This extends operating periods and reduces maintenance time. Furthermore the unit features easy handling when opening the solid bolted housing. This allows quick access to the fully welded plate pack, which considerably simplifies cleaning and maintenance with resulting savings in both time and costs.

The connector arrangement is flexible and can be freely selected to match individual process requirements, the connecting nozzles being variable. This prevents any unnecessary pressure loss at the connection, leading to ideal flow in the plate pack. Constant flow characteristics are ensured to guarantee the required process reliability.

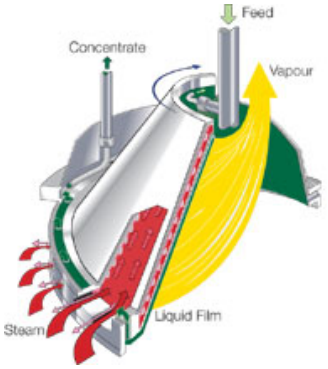


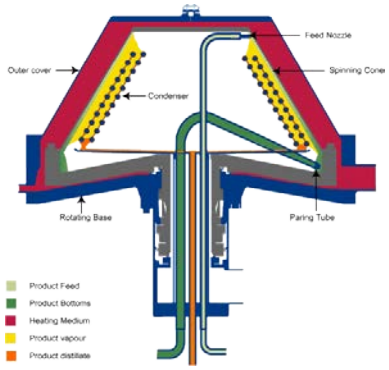
http://www.gea-heatexchangers.com/nc/news-exhibitions/news/news/article/free-flow-for-all-media/

15. Spinning cone thin-film evaporator.

FT Technologies (Griffith, Australia) manufactures intensified evaporator type called Centritherm. Centritherm® evaporator is a thin-film, spinning cone evaporator. The Centritherm® evaporator, with its unique design, develops the thinnest liquid film possible in any evaporator system - the film is only 0.1 mm thick and crosses the heating surface in about 1 second. In this brief time the liquid receives all the heat it needs to evaporate the product to its final concentration.

The Centritherm® evaporator is a compact unit particularly suited for the concentration of heat-sensitive, valuable and viscous products. It offers an exceptionally short residence time, less thermal impact and much greater processing flexibility than traditional rising or falling film evaporators.





More than 1,000 Centritherm® evaporator units have been delivered worldwide so far, for wide variety of applications in industries such as the pharmaceutical, fruit and vegetable, coffee, tea, nutraceutical (e.g. herbal extracts), chemical and biochemical industries.

http://www.ftindustrial.com/Technologies/Centritherm/centritherm.html