Green Chemistry Meshes Well At Activated Carbon Conference

By Ken Ball

Introduction: *With the business side of activated carbon tightly bound to the well-being of the environment; widespread industry support for "Green Chemistry" is to be expected. However, a conference synergism evolved as real world applications described by industry speakers closely paralleled global needs and goals presented by green chemistry academics and Water Quality Ass'n representatives.*

The 30th Annual International Activated Carbon Conference was held at Pittsburgh on 4, 5 October 2012. Organized by the non-profit Professional Analytical and Consulting Services (PACS) Group, conference topics largely covered leading edge activated carbon and related technologies. Annual PACS programs include a selection of 1-day short courses preceding and following the conference. As always, the conference was functionally international including speakers and attendees from India, Sri Lanka, Brazil, Singapore, Columbia, and Peru.

Activated Carbon & Green Chemistry

The conference plenary lecture was delivered by a world renowned green chemistry pioneer -- Carnegie Mellon University Chemistry Professor Terry Collins, Head of CMU's Institute for Green Science and the Teresa Heinz Professor in Green Chemistry. Dr. Sarah Kennedy, a colleague of Dr. Collins, presented a paper on green chemistry principals for sustainability.

Dr. Collins' presentation quickly gained audience attention and reinforced the urgency for increased green chemistry efforts in industry, commerce, and governments as well as in academic curricula. Global scale concerns included:

- The human population has outgrown the planet.
- Our global water cycle is collapsing.
- Polar ice loss and receding glaciers are increasing ocean levels 1.2-to-1.4 inches per decade.
- Burning PVC with waste combustion is the world's biggest source of dioxins.
- Simply extracting & processing resources; dumping wastes; and scrapping products can no longer be justified.

Generalities were backed by facts and examples. His "status report" on the condition of the world's oceans and sea life was especially disturbing. He commended the progress of the Germans who now obtain 25 % of their energy needs from renewable sources.

Professor Collins disclosed recent findings that show long term effects to very low amounts of hazardous materials. He mentioned a study wherein parts-per-trillion exposures of pharmaceutical compounds on rats led to subtle reproductive changes such that only females were produced after nine generations. He pointed out that few chemists study toxicology and recent findings indicate that longer term exposures as well as current toxic limits must be further evaluated.

Beyond his advocacy for green chemistry., his research team has invented tetra-amido macrocyclic ligand (TAML) catalysts which activate hydrogen peroxide to destroy water many common water and soil contaminants. This approach may obviate more troublesome chlorine chemicals in water treatment applications. Prof Collins contact is: tc1u@andrew.cmu.edu

Developing A Culture of Sustainability Using Green Chemistry Principles

Dr. Sarah Kennedy; Ass't Prof; Dep't of Chemistry; Westminster College

Dr. Kennedy cited a new Green Chemistry Journal published by the Royal Society of Chemistry as well as frequent case studies published by the American Chemical Society. A number of case studies report business benefits due to sustainability advantages of green chemistry approaches for new and revised products and processes.Curricula for college level green chemistry courses are developing rapidly and the courses are quite popular among chemistry majors. Green chemistry curricula imparts a basic philosophy for newly trained chemists to inherently consider chemical processes that will eliminate or reduce the use and generation of hazardous substances. Prof Kennedy contacts are: kennedsa@westminster.edu Ph: 724-946-6289

Removal of Dibromochloropropane From Drinking Water: Laboratory and Field Experiences

Dr. Thomas Klasson; Research Leader; USDA-ARS South Regional Research Center

Almond crops worldwide amounted to some 1.8 million tons in 2007; of which about 1.68 million tons or 93 % were grown in the US. California is by far the leading grower of almonds -- producing 1.35 million tons in 2007 or about 75 % of the world's supply. Over 738,000 acres of almond orchards are cultivated in California and almonds have become a top US Specialty Crop Export worth $1.88 billion in 2007 dollars. (The 2007 almond commerce data was easily accessed and the ratios appear to hold for the more recent years).

Shelled almond products result in some 518,000 tons of shells produced annually as byproducts along with substantial amounts of almond hulls. Much of the latter are utilized as cattle feed supplements but little use -- other than as boiler fuels -- has been found for the shells.

A chronic problem with almond tree growth are nematodes which can be controlled by fumigants containing dibromochloropropane (DBCP). California's almond groves are largely flood irrigated and trace amounts of fumigants contaminate the ground waters. Typical DBCP contamination levels are in the 28 ppb range whereas the allowable drinking water limit is 0.2 ppb. Activated carbons have proven to be effective in suitably reducing DBCP levels.

Dr. Klasson's team evaluated various almond shells and activation processes; eventually showing that (1) most steam activated almond shell chars performed about as well for DBCP removal as commercial carbons, and (2) use of locally available shells appears economically viable as a filtration media for California's almond acreage.

Dr. Klasson also outlined the USDA's Commodity Utilization Research Team's general purpose and several ongoing projects. Basically, his team attempts to utilize plant or animal wastes to minimize adverse ecological impacts of such materials -- largely by developing processes by which wastes can be converted to useful materials of some economic value. Wastes being investigated include chicken, turkey, duck, and swine manures as well as manure litter, seeds, and nutshells. One such project has demonstrated ppb mercury removals from hot flue gas using powdered carbons from processed manures. In effect, such USDA efforts are prime examples of green chemistry being applied. Dr. Klasson contacts are: Thomas.Klasson@ARS.USDA.Gov Ph: 504-286-4511

Advanced Carbon Dioxide Capture Utilizing PVDC Based Activated Carbon

Neal Megonnell; Director -- Platform Marketing; ATMI; Danbury, CT

Carbon capture continues to be of high interest with respect to fossil fuel emissions. A 2008 global market value was estimated at 92 billion Euros at a CO2 credit value of 20 Euros per ton. Significantly

reducing carbon dioxide emissions from large scale operations such as power plants involve complex and costly systems. At present, amine based capture processes appear to be the technology of choice but working system costs are excessive.

Based on carbon molecular sieve research at SRI, Advanced Technology Materials Inc (ATMI) has developed a porous solid media which has shown a high capacity for adsorbing CO2 in hostile environments such as power plant flue gases. At one atmosphere, the solid media will adsorb 20 weight percent of CO2 with a capture efficiency in the 90 % range. Cyclically desorbed CO2 is about 98 % pure and tests of more than 7000 cycles have shown no reduction in capture efficiency.

The lightweight, porous media is a polyvinylidene chloride based activated carbon. Currently, a 40-foot column unit is undergoing tests at the University of Toledo. Also operational power plant testing is scheduled at the Clean Coal demonstration facility at Wilsonville, AL. Neal Megonnell contacts are: nmegonnell@atmi.com Ph: 412-835-5281

Activated Carbon Demand and Supply

Dr. Henry Nowicki; President PACS Labs

A history of and advanced testing methods for evaluating activated carbon adsorption capabilities were described. Dr. Nowicki also covered a Freedonia Group Marketing Report wherein expected near-future demands for activated carbons are quite optimistic -- not at all reflecting current sluggish economics. Freedonia estimates world demands will increase by more than 10 % per year over the 5-year span from 2011-to-2016. Freedonia's projections are listed in Table 1.

TABLE 1 -- WORLD ACTIVATED CARBON DEMANDS (In 10^3 Metric Tons)

	YEAR			% ANNUAL GROWTH	
Activated Carbon Demands	2006	2011	2016	2006-2011	2011-2016
North America	250.9	325.0	642.0	5.3 %	14.6 %
Western Europe	158.5	180.0	228.5	2.6 %	4.9 %
Asia Pacific	316.0	464.5	729.5	8.0 %	10.0 %
Other	152.0	210.5	310.0	6.7 %	8.0 %
Total	877.6	1180.0	1930.0	6.1 %	10.3 %

It may be noted that the major growth in demand is Asia-based with China expected to lead due to widespread needs for improved water and air qualities as well as purifications of processed edibles. India will likely surpass Germany as the 4th largest market after the US, China and Japan. Dr. Nowicki contacts are Henrypacs@aol.com Ph: 724-457-6576

Journey From Shell To Black Gold

Dr. Srilal Weersinghe; United Carbon Solutions; Tamil Nadu, India

Some 1.9 million hectares of coconuts are cultivated in India producing 13 billion coconuts annually. United Carbon Solutions is India's largest processor of coconut shells; producing coconut shell activated carbons, coconut shell chars, and utilizing shell materials as a renewable source for process heat. Dr. Weersinghe reported that coconut shell char applications are rapidly increasing and United Carbon is now producing over 9000 metric tons per month. Dr. Weersinghe contact is: info@ucsplgroup.com

A complete Conference Proceedings; future conference and training schedules; PACS Services and additional information is available by phoning 724-457-6576 or e-mailing: Henrypacs@aol.com.

About the author

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