Australian Institute of Physics NSW Branch (August News)

The August meeting of the NSW branch of the AIP was held at the University of Sydney on Tuesday 18 August 2009 and featured a public talk by Dr Tony Farmer. Dr Farmer is the Deputy Chief of Operations at the CSIRO and is responsible for managing the six sites that make up CSIRO Materials Science and Engineering. Tony's research interests include spectrophotometry/radiometry, gas discharges/plasma spectroscopy, sub-surface radar, sensing systems/intelligent networks and, most recently, high-power ultrasonic's which his talk was based on High-Power Ultrasonic's and its Applications.

Dr Farmer explained that a small sonochemistry group at the CSIRO Division of Materials Science and Engineering has been investigating the science and applications of ultrasound at high power levels for the past decade or so. Ultrasound process technology is a unique method for the activation and acceleration of processes in chemistry, petrochemistry, and biotechnology. In chemical synthesis, ultrasound supports organometal intermediary products and promotes most types of catalytic processes. Moreover, ultrasound has a generally accelerating and favourable impact on heterogeneous reactions. Tony outlined some of the intriguing effects produced by high-density ultrasonic fields in liquids and gases and in particular in a wide range of applications for this technology covering areas as diverse as mining, energy, health and food. Pouring beer or soft drink slowly so it doesn't foam up over the top of your glass is something with which we are all familiar. Foaming overflow is a much bigger problem in commercial bottling plants. The idea of using sound waves to destroy bubbles is not new, but getting it to work is far from easy. The most difficult part is getting enough energy across the air gap between the source of the noise and into the foam. Tony explained that CSIRO is developing a compact unit to be mounted above bottles on the production line. As bottles are filled, they pass under this unit which generates pulses of high-power ultrasound. The sound is at the right frequency to destroy the bubbles and it has enough intensity to cross the air gap and get into the foam.

Some of outcomes that have resulted have included the CSIRO ultrasonic generator is compact and fits easily on existing bottling lines. It is currently undergoing industry trials. CSIRO's defoaming technology improves bottling efficiency. The technology has been found to be effective in defoaming:

- Carbonated beverages such as soft drink.
- Beer.
- Liquids with a high protein content, such as milk.

This technology could save bottlers money by:

- Saving energy
- Speeding up the bottling process
- Minimising waste and mess from overflow
- Reducing the number of under-filled containers.

Some further applications that were discussed included this technology is theoretically applicable to any situation where liquids generate unwanted froth or foam, either in the production process or as they are being packaged. Examples include:

- fermentation vats
- cosmetics
- pharmaceuticals
- Personal care products.

Dr Farmer's presentation also focused on the following sections:

1. **Mineral processing applications**:
   - Surface cleaning of silica and heavy minerals.
   - Leaching.
   - Flotation.
   - Mineral sands separation.
   - 'Red Mud' from the Bayer Process.

2. **Red Mud Waste from the Bayer Alumina Process**:
   - Australia is the world largest producer of alumina – 19M tones in 2007.
   - Bayer process produces 2 tonnes of red mud waste per tonne of Alumina.
   - Strongly alkaline.
   - Highly thixotropic – viscosity changes with time.

- Develops into a sticky gel does not flow readily.
- Large waste stockpiles.
- Possible source of iron - contains ~ 60% Fe_2O_3.
- Treatment with high power ultrasound assists in breaking down the gel – a temporary situation.
- Treatment with ultrasound followed by Wet High Intensity Magnetic Separation can separate the Magnetic (Fe) fraction from the non-magnetic.
- China is currently selling iron ore at 82% Fe_2O_3.

3. **Ultrasonic – De-foaming**:
    - Carbonated Beverages - The problem. Filling techniques coupled with mechanical agitation (vibration) of bottles through the filling/sealing process often generates excessive foaming. This leads to:
        - Products/syrup loss.
        - Issues associated with waste treatment discharge.
        - Decreased production capacity from reduced line speed and lower resource use.
        - Increased energy usage (product cooling).
    - **Application Issues**: ultrasound in air, size, energy consumption, splashing, acoustic noise and concentration of ultrasonic power.
    - Other de-foaming applications: fermentation vats, fruit juice processing/extraction, soy-based liquids, beer brewing.
    - **Applications**: soil remediation, organic-chloride-pesticides, poly aromatic, poly-chlorinated Biphenyls.

4. **Current Remediation Technologies**:
    - High temperature incineration, plasma arc, base catalyzed dechlorination, ecological hydrogenation, and bioremediation.
    - All these have only limited success.

Photo: From left to right, Dr Fred Osman (AIP Branch Chair), Dr Tony Farmer and Dr James Downes (AIP Committee Member).

The talk was very well received and geared to scientists and members of the public alike with many discussions continuing later during dinner at a nearby Italian restaurant. The Australian Institute of Physics thanks Dr Farmer for his outstanding lecture!

Dr Frederick Osman - AIP NSW Branch Chair