

**WASTE FORUM “TVIP 2019”
Hustopeče, Czech Republic; 19-21.03.19**

The following minutes summarize the Czech environmental conference. The three days of lectures and posters treated several aspects of environmental management, including water, sludge/solid waste and air-related issues. The majority of the approximately 175 attendees included were from SMEs. Government agencies and public research institutes in Czech and Slovakia were also present, with some international representation. Separating the themes over different sessions had the effect that some attendees were only present on one day. Each session of the congress focused on a given theme: water, air, economics/regulation and waste. Overall, one can see, increasingly, that the so-called advanced technologies, such as membrane bioreactors and ceramic membranes are moving, increasingly, to the forefront.

There is an increase in the level of funding for environmental projects which identify reuse and recycling opportunities. There is also progress made in European countries. Many new firms have been created in the environmental area and these will compete with existing companies trying to add an eco-profile to their activities. Overall, with each generation, environmental action increases. Being present and established presents an important opportunity.

WATER (March 19, 2019 Afternoon)

A series of lectures were presented, a summary of which is appended.

Modern Technology for Water Treatment (Simona Kubickova, [ENVI-PUR sro](#))

A membrane bioreactor was used to reduce the level of VOCs. One example was for a brewery with a flow of 20 m³/h. They focus on small plants, some of which use a simple chemical pre-treatment (e.g. neutralization and a metal coagulant). They are regulated for nitrogen, phosphorous as well as BOD₅. One of their projects involved flocculation and membranes, the later consisting of both polymeric (up to 45C) and ceramic, working to 80C.

(kubickova@envi-pur.cz; www.envi-pur.cz)

Zero Liquid Discharge (Pavel Kovanda, Kovofinis sro)

A low-liquid discharge system requires very high energy levels and has a highly concentrated side/waste stream. Their process includes neutralization, sedimentation, filtration, reverse osmosis membranes, crystallization (which yields a concentrate) and filtration (activated carbon). They did not address situations where ZLD might be economically justifiable. Dusan Berek commented that most of the firms as assembling systems from purchased components, the so-called “lego” model.

(www.kovofinis.cz)

Removal of Ions of Harmful Metals from Water via a Composite Sorbent (Dusan Berek)

Porous carbon fibres are made from the carbonization of industrial delignified cellulose (e.g. from pulp or cotton wool). Native raw cellulose was also used (e.g. Yute). Narrow pores were introduced via “porogens” which are mainly Zn salts, as well as P and B substances (size 0.6 nm). The pores must be small enough to prevent the penetration of the precursors which are used to generate nanoparticles of about 50 nm on the surface.

The efficiency of removal of ions was quite high, with arsenic reductions over 97%. Antimony (84%), as well as other heavy metals such as lead, cadmium, selenium, chromium and nickel could also be removed, as could radio-nucleotides. Dusan alluded to the de-coloration work, though did not provide visual examples.

Water Treatment via Coagulation and Flocculation (David Hunkeler)

There was one question after the presentation related to the availability of the products demonstrated in the lecture, including for academic applications. DH responded that we are transparent in regards to the the physical chemical properties of our polymers and are happy to supply to academic institutes. In his presentation he also referred to an earlier lecture on the life cycle assessment of sludge dewatering and treatment. There was some interest in the lecture as the audience, and even the organizers, were taking photos of several of the case study slides.

Water Structure (Radovan Sejvl, Energis 24)

The effect of a spiral gradient in magnetic field on conductivity was simulated. Dipole interactions are postulated to account for water structures of up to 200-400 molecules. They are contacting water with stainless steel rods or equipment and claiming to change the structure and, thereby, provide health benefits. This is a highly controversial field, discredited in the most important scientific journals. One might say that this linking or polymerization of water is a kind of alchemy not so unlike trying to convert metals into gold. (www.energis24.cz)

AIR (March 19, 2019 Afternoon)

The session on air had a mix of research institutes and SMEs presenting, as is noted in the following section.

Pilot Plant Scrubbing Experiments (Boleslav Zach, Chemical Process Fundamentals., Czech)

Sulphur dioxide was reduced from 500 to below 50 mg/m³ of air, the emission limit. The lecture came from the "Waste-to-Energy Competence Centre".

Degradation Products Analyzed by Gas Chromatography (Thomas Korba, Amedis sro, Praha)

The lecture basically presented a new detector for gas chromatography. GC-VUV (visual-ultraviolet) can differentiate isomers. The lecture included some discussion as to how to deconvolute co-eluting peaks. They looked at gasoline samples and analyzed paraffins, olefins, naphthenes, aromatics, diolefins, isoparaffins as well as oxygenates. VUV is complementary to mass spec.

Zeolites for Mercury (Pavel Kus, Centrum Vyzkumu Rez sro, Pavel Kobulez, Zeochem a.s.)

Zeolites were applied as sorbents to mercury removal. They compared their synthetic zeolite to some standard ones including bentonite. It had good Hg removal, though some commercial materials outperformed it.

Chemically Modified Absorbents (Marek Staf, VSCHT Institute, Prague)

The pore size and surface chemistry have been modified. The specific surface area was up to 300 m²/gram, which is modest. The products have not yet been tested.

Optimizing Pilot Packed Columns (Tomas Moucha; VSCHT Institute, Prague)

They are evaluating a injector design, coupled with recycling, with the goal of reducing emissions.

ECONOMY and REGULATION (March 20, 2019 Morning)

This section included a presentation of public programs, legislation and some examples of how firms are involved in recycling.

Legislation in the Czech Republic (Milos Kuzvart, Czech Recycling Association)

The investment in recycling will be approximately 1.5 Billion USD between 2019-2024 with some support from the EU.

European Horizon 2020 Program (Jana Cejkova, Technology Centrum)

The Horizon program does include a part on building a low-carbon climate. There is another on "greening" the economy. Each have approximately EUR 190M in funding allocated. Other programs include those for carbon-neutral cities, climate resistant coastal cities, fires as well as water policy streamlining and water security. There are a number of programs for the polar regions and mountains. Others relate to raw material re-use, sorting of multi-layer materials and the circular economy. The projects tend to be large with an average size over EUR 5M. AquaTECH will not continue seeking public funding as the resources needed to apply take time away from our, already limited, core development activities.

Recycling Economics (Magdalena Zimova, SZU, Prague)

As is the case in many countries, the recycling of some materials, such as PET, is developed. One of the criteria for justifying recovery is the energy available per cubic meter. Some substances are now regulated (e.g. PCBs, formaldehyde, PAH). The presenter also commented on the issue of bacteria developing resistance to antibiotics. She concluded by questioning if society would act in regards to solid and liquid waste or procrastinate as it has with, ever increasing levels of atmospheric emissions.

innovative Materials (Eliska Knotkova, **MateriO** (consultant), Prague)

There are over 160,000 materials in contact with humans. MateriO gave several examples of replacing virgin sources with waste. Econyl is a material made from recycled plastics. It is used for stockings and watch bands. Malai is a cellulose based and biodegradable. Biomass based sources have lead to agraloop, made from pineapple leaves as well as stalk from banana, flax, hemp and cane bagasse. These five crops provide 250MT of fibre per year, 2.5x the global demand (www.materio.cz).

Recycling Oily Products (Jan Skolit, **Classic Oil sro**, Bustehrad)

Over the last fifteen years, the volume of oil recovered from waste has multiplied by a factor of four. Glycol is now recovered by garages. There are some constraints in recycling such as the concentration of residual salts (0.5%) and metals. Processing can include neutralization, filtration, coagulation, adsorption, filtration and electro dialysis. Examples of ethylene glycol and propylene glycol were presented. The company seems to process on a small scale, with many of their tanks being only 2-3 cubic meters. However, their total production capacity is 10kT/year..

Bioplastics (Vladimira Matuskova, Nafigate Corp, as)

PHA and PHB production is growing, though slowly. There was some discussion of plastics which could be composted.

Circular Economy (Karel Prokes, Agmeco LT, sro)

As one moves from the philosophy of a circular economy, to proposing examples, this tends to generate some controversy.

Circular Economy from a Materials Perspective (Frantisek Voros, Sduzeni EPS (consulting))

Plastics production increased 5% globally over the last year, 7% in Europe. Germany, France, the UK, Italy and Poland consume approximately 2/3 of the plastic. The main products are polyethylene (34%), polypropylene (24%) and PCC (17%). The most important segment is in packaging. Of recovered plastic, 31% is recycled, 41% incinerated for energy recovery and 27% landfilled. This is a recent trend and, only in 2016 did the amount recycled exceed the amount buried in Europe. Switzerland leads Europe with the lowest percentage of landfill, though most of the plastic is burned. Germany and some other countries have higher recycling levels. The recycling community is quite fragmented, with over 1000 SMEs involved across Europe (www.epscr.cz).

The afternoon program terminated with tours of industrial facilities. Dusan Berek and DH elected to see the nuclear power plant which was mostly a question and answer session.

POSTER SESSION

The economic/recycling part of the meeting was divided in two by a poster session. There was a very nice paper on the degradation of antibiotics, such as one might see in runoff from farms, via oxidation. There was also a paper from a company where they were taking sludge, processing it to a powder and then using this to remove arsenic from water.

WASTE (March 21, 2019 Morning)

The EC's "WasteEN" project involves more than 10 Czech companies and has several demonstration projects. A summary of the lectures presented is included. In almost all cases, the presentation of the recycling activities of various companies stimulated a, somewhat contentious, discussion as to the interpretation of the data.

Waste Management in Europe and Slovakia: (Michal Stricik, Economic University of Bratislava)

The end-of-life of solid waste differs greatly in the various European countries. As an example, over 52% of waste in Sweden is recovered for energy with less than none in Romania. This indicates that environmental activity has a political axes.

In Slovakia a survey showed that plastic, glass and paper are the three materials which are the most recycled (all at about 90%). There is certainly a financial motivation in recovery. As the recovery percentage of a material rises from 10 to 60%, the cost of treatment is reduced by a factor of approximately three.

Statistical Analysis of Waste Management (Radovan Samplok, Institute of Process Technology)

A typical town was analyzed in terms of the use and efficiency of its recycling centre. A preliminary economic model has been developed which includes the distance to the recycling centre as well as the volume deposited.

Energy Balances in Degradation Processes (Jaroslav Stoklasa, Centrum Vyzkuma Rez sro)

The life cycle perspective was applied to qualitatively examine nuclear processes including a fission reactor (Tokamak).

Energy Waste Recovery and Gas Treatment (Barbara Grycova TU Ostrava)

The presentation reviewed the activities of the environmental institute. These include the development of a new furnace lining for incineration, continuous combustion and pyrolysis, pilot anaerobic digestion. Academic researches from around the world can apply to use the facilities.

Analysis of Solid Waste Recycling Parameters (Robert Procazka, VUMZ SK sro)

The study assumes that solid waste will be increasingly used for value recovery. They foresee a marginal decade by decade improvement, for example from 60 to 70% from 2020 to 2030. Some examples of technology in Bratislava and Nitra were presented. Sorting includes NIR/VIS sensors. Equipment now exists for municipalities to invest in once they finance solid waste recovery.

Equipment for Solid Waste Processing (Zbynek Proksan, FF Servis spol sro)

Some examples of lab, pilot and full scale equipment were presented for solid waste management. Some of the projects realized generate pellets as waste, presumably combustible. Some composite material is made into the interior filler of floor boards.

Modern Solid Waste Recycling in Czechia (Michal Syc, VVV Most sro)

Separation techniques were reviewed, including the magnetic separation of non-ferrous metals from ash which is based on a time-of-flight concept. For a typical Czech waste glass accounts for about 20% of the mass, the magnetic fraction 10%, ferrous scrap 10% and ceramics 5%. There is a residual of 25%, while particles below 2 mm account for 30% of the weight. Over the years the recovery from the magnetic separation is slightly improving. Recovered materials include the ferrous and non-ferrous wastes and some solid which seems to be re-used in road construction.

Implications for aquaTECH

From aquaTECH's perspective, ENVI-PUR could be a potential reseller and Classic Oil could be a client. The presentation of both are given below. The consulting firm MateriO has a data base of recycled materials and could be, as well, interested in helping us with identifying ways to close the loop in water. These are highlighted in **blue** in the minutes.

Nomenclature on Corporate Suffix

Please note that the suffix "sro" is an abbreviation for a limited liability company much like "SArI" in Switzerland. An "a.s." is a joint stock company, like our "SA" in CH or a corporation "Inc".

David Hunkeler; 21.03.19