#SCOPE NEWSLETTER

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special edition : Chemosphere & Toulouse seminar

Chemosphere
The Phosphorus Cycle

Chemosphere Special Issue

The Phosphorus Cycle

The special issue of Chemosphere on The Phosphorus Cycle (August 2011) offers 15 papers providing state-of-the-art science on phosphorus consumption and reserves, understanding of geological phosphorus cycles, phosphorus flows at global regional levels, P-use efficiency in agricultural and food systems and an overview of the potential for recovering phosphorus from waste streams.

Chemosphere journal (Elsevier publishers) special issue on "The Phosphorus Cycle": Chemosphere, Volume 84, Issue 6, Pages 735-854 (August 2011).

Individual articles can be purchased on the Elsevier ScienceDirect website:
http://www.sciencedirect.com/science/journal/00456535/84/6
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Toulouse seminar:
P-recovery and reuse

Toulouse France

Innovation conference: phosphorus recovery and reuse

The meeting of phosphorus recycling organised in the frame of the ANR Phosph'OR research project by Midi-Pyrénées Innovation brought together scientists, industry, water companies and agricultural organisations to exchange on perspectives for recovery of phosphorus from waste streams, and market and agronomic criteria for distribution and reuse of recycled phosphorus as fertilisers according to farmers' needs.

"Phosphorus Seminar: Recycling and use of phosphorus from waste streams, solutions to the depletion of natural resources". 23rd November 2011, Toulouse, France (Midi-Pyrénées Innovation, Cemagref, LISBP-INSA):

Seminar presentations are available online (in French) at: http://www.mp-i.fr/ *(click: "Participer aux journées" then "Retour sur les journées")*

Other news

Analysis kit

Phosphate analysis on site

envolure enalyse has developed an analysis kit enabling rapid analysis of phosphate concentrations, adapted for use on site in laboratory, pilot or industrial phosphorus recovery installations

P losses

Food Waste

EU politicians have suggested an objective of cutting food waste by 50% by 2025. The UK Government has issues guidance to reduce food waste resulting from "sell by" dates.

Conferences

Phosphates 2012

Phosphate industry conference

Major 2-yearly conference for the worldwide phosphate industry (rock production, fertiliser, animal feeds, food, detergents, other industrial uses). El-Jadida, Morocoo, 19th - 21st March 2012:

http://www.crugroup.com/events/phosphates/

Science and policy

3rd sustainable phosphorus summit

29th February – 2nd March 2012, Sydney, Australia

http://sustainablepsummit.net/

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Publication

Chemosphere Special Issue

The Phosphorus Cycle

The Special Issue editor, David Vaccari, starts by reminding that phosphorus is essential for all life, for example in bones, DNA, cell membranes and in cell energy metabolism (ATP), that modern agriculture and world food production are utterly dependent on mineral phosphate inputs and account for around 95% of use of mined phosphate rock - but that only around 17% of this phosphate rock finally ends up being consumed in human food. Much of the phosphorus lost along the way, along with much of the P in human excreted wastes, ends up in the environment, causing excessive plant and algal growth (eutrophication).

This issue of Chemosphere responds to growing scientific and decision maker awareness that phosphorus is not only a pollution problem, if discharges are not adequately controlled, but also a vital resources issue.

Mineral phosphate rock resources are non-renewable. There are considerable debates about quantities of resources, both known and possibly remaining to be discovered, about the feasibility of exploiting lower quality or inaccessible reserves, and about levels of future demand and consumption. Nonetheless, in the long term, and so in terms of sustainability, the depletion of phosphate reserves is an inescapable issue.

At some time in the future, **fundamental changes will have to take place in society in order to reduce our phosphate consumption by maybe two-thirds**, in order to live within the limits of feasible phosphorus recycling. For Mr Vaccari, whatever the time scale for this, there is no reason to delay actions to move in this direction, and the development and circulation of scientific knowledge is a key to doing this.

Chemosphere Contents

History and perspectives for human phosphorus management

Ashley et al. provide an overview of the history of human interactions with the natural phosphorus cycle, from the cycling of phosphorus in historical food systems, to discovery of the element Phosphorus by Henning Brandt around 1669 and to the questions raised about global phosphorus security today. Human societies historically managed phosphorus (by patchwork burning of vegetation to release P) or stewarded and recycled it (through collection of human excreta or animal manure, keeping pigeons for P-rich manure, spreading small marine fish on fields.

Such recycling ceased for increasing populations with **'Sanitation Revolution'** and the implementation of sewage collection and centralised treatment. The discovery of phosphate fertilisers and the **'Green Revolution'** led to today's society's complete dependence on phosphate rock to feed the world's population. At the same time, untreated sewage phosphorus discharges and loss of agricultural soil phosphorus to surface waters results in major environmental problems (eutrophication). Phosphorus is now recognised to be a scarce, non-renewable resource.

The authors conclude that **major societal changes will be needed to reduce society's "phosphorus footprint".**

Cordell et al. propose a systems framework for decision making for phosphorus recovery and reuse, including assessing system boundaries, drivers, quantities, technologies, logistics, life-cycle costs, synergies (sanitation, energy, food …) and identifying stakeholder and institutional arrangements. Each of these steps is examined. Phosphorus concentrations of different waste streams are summarised, as are possible points for P-recovery in a quantified society phosphorus flow diagram, and a matrix of possible recovery technologies for different waste streams. 6 case studies are assessed: household scale urine P-recovery, ecological sanitation in Niger, decentralised P-recovery and biogas production in India, struvite recovery in municipal waste water treatment plants, P-recovery from sewage sludge incineration ash (Thermphos, Netherlands), manure separation and reuse.

Revisiting the geological history of phosphate rock deposits

Filippelli presents a 'deep time' perspective of phosphate rock formation and marine phosphorus geochemistry. The geological time scale and quantities of phosphate rock formation and deposits are compared to current phosphate rock consumption rates. Until quite recently, it was generally assumed that the formation of phosphate rock deposits was linked to global conditions over a certain time period, for example increased ocean P concentrations, resulting from changes in the rate of surface rock weathering related to climate changes. However, it is now clear that mineralisation of P-rich materials in ocean sediments is predictable, but that the production of P-rich layers or nodules depends on **specific local conditions**, where high local biological production and sedimentation occur, and that the concentration into exploitable phosphate rock then depends on specific local geological conditions.

The author concludes by assessing what this new knowledge implies for future phosphate rock supplies. He emphasises that the **high quality, low cost resources have already been exploited**. New technologies will certainly be developed to exploit difficultly accessible resources, for example offshore, or low quality materials (low P content, high levels of impurities), but inevitably **only at increasing cost and with increasing energy and environment impacts**.

Phosphate stewardship and recycling are thus essential.

Phosphorus flows

Matsubae et al., Qiao et al. and Baker present assessments of phosphorus flows for the country level in Japan, for two megacities in China and for the Twin Cities watershed, Minnesota, USA. By assessing the complete substance from for phosphorus in Japan, Matsubae assesses the 'virtual' or 'embedded' phosphorus requirement of the country's economy, showing that Japan's total phosphorus requirement is twice as high as the domestic consumption of phosphate fertiliser. **Only around 12% of total imported phosphorus is finally consumed in human food** (imported in phosphate rock, fertilisers, in food and animal feeds and in other products), somewhat less ends up in industrial products, and somewhat more ends up in steel or steel production slag. **Nearly half of total imported phosphorus ends up accumulating in soils**.

The situation for the two Chinese megacities of Tianjin and Beijing is somewhat different, with **over half of phosphorus flow ending up, via sewage sludges, in landfill**. The uncollected sewage and inadequately treated sewage (effluent discharges) have major negative environmental impacts. The authors conclude that phosphorus recycling in sewage works is essential both to reduce discharges and to close the nutrient cycle.

Baker estimates that **most of the phosphorus entering the Twin Cities watershed is stored within it (61%), principally in sewage sludge, or is leaked from it (31%),** principally in sewage works discharge effluent. Only 4% is deliberately exported as useful products. The author concludes that P-recovery and recycling must be developed to avoid a "brown devolution" if mineral phosphate rock resources become too depleted to support the world's growing population.

Luo et al. assess atmospheric phosphorus deposition on Lake Taihu, China's largest freshwater lake, on which 34 million people depend for water resources. Annual atmospheric deposition is estimated at 0.04 – 0.44 kgP/ha/year dry deposition plus 0.33 kg/ha/year wet deposition, and in total is less than 8% of riverine phosphorus input to the lake.

Phosphorus resources and global food supply

Vaccari and Strigul assess to what extent it is possible to estimate phosphate resources from known data and trends such as resource price, ore grade and discovery rates, using Hubbert curve extrapolation.

They note that the **Hubbert curve**, which predicted US oil production, might not be applicable to global resources, nor for materials for which there is no possible substitute (such as phosphorus), and that Hubbert indicated that production might pass through one or more peaks. They conclude that the bell-shaped curve is **unlikely to provide robust predictions of "peak" phosphorus production**, given that the ultimately recoverable resource (URR) quantities are unknown. They note that factors such as population growth and economic development will considerably modify phosphorus consumption, and that given that phosphorus is essential for feeding mankind, efforts should be engaged to collect better data and build better models.

Dumas et al. develop a model to relate total soil phosphorus to bioavailable phosphorus to crop yields. This is an essential part of modelling phosphorus cycles, because of the very high quantities of phosphorus stored in agricultural soils and cycled between soils and crops, fertilisers, recycled biosolids and soil erosion annually. The model takes into account both natural and biological processes, such as weathering and soil biology, and human-managed phosphorus flows.

The authors note that there is **very little data available on total soil phosphorus pools**, despite this representing a huge potential "resource" of phosphorus.

Phosphorus flows and use efficiency through to food consumption

Suh and Lee develop a phosphorus flow assessment from mining through to household food consumption for the USA and assess PUE (Phosphorus Use Efficiency). The model includes mining efficiency, fertiliser use, crop cultivation, animal production, food production and household food use (consumption or food waste).

The authors conclude that, in the USA, only 15% of phosphorus from mined phosphate rock reaches food which is eaten by humans, 11% is lost in mining and fertiliser manufacturing, 20% is lost as run off from cropland and livestock, 46% is accumulated in soils (from crops and livestock), 5% is lost in household food waste and 1% in food industry wastes. Overall, two thirds of phosphorus is lost in farming.

Sensitivity analysis suggests that **key points for improving efficiency of phosphorus resource use are in improving farming yields** (production efficiency of food crops, animal feed crops, meat, dairy products) and in **reducing household food waste**. The authors note that agricultural products and foods are highly subsidised in the USA, and that correcting food prices (whilst protecting low income families) would be an important approach to reduce food wastes.

Phosphorus flows and use efficiency through different crops

Ma et al. present the NUFER model (Nutrient flows in chains, environment and resource use), and its application to assess phosphorus flows and use efficiencies in the production of rice, wheat and maize in China. Fertiliser input for each crop was estimated by multiplying the planted area in China by P fertiliser application rates and other phosphorus application rates. Phosphorus food output was estimated by multiplying total crop productions by P-content for each crop. **A phosphorus flow model was built up and a phosphorus balance established for each crop**, including P-supply, fertiliser use, grains for food, crop used for fodder, fodder, crop by-products and crop going to human food production.

The authors conclude that only 3.2% of fertiliser phosphorus applied to wheat ends up in human food, 2.6% for rice and just 0.9% for maize. They suggest that the annual 40 billion Yuan subsidies to fertiliser production and use in China are encouraging inefficient use, and high levels of loss in farming or over-application resulting in accumulation in soils. The massive use of phosphorus fertiliser, low efficiency and high surplus P application are causing significant environmental problems, through losses of phosphorus both from crop fields and from animal manures.

Improving P use in agriculture

Schröder et al. address the questions regarding agricultural P use efficiency (PUE) in the above papers. As with the above authors, they show that in many parts of the world, phosphorus is being over-applied in agriculture. For the European Union, they estimate surplus application of 5 kgP/ha/year, close to the 8 kgP/ha/year surplus estimated by Richards and Dawson (see SCOPE Newsletter n° 80), but with wide differences between countries.

The authors propose a number of routes for improving agricultural P use efficiency:

- **optimising land use**: in particular, high meat and dairy diets and bio-energy crops increase land use, and so push to use land where P-losses will be higher because of climatic or local conditions
- **preventing soil erosion**: because it adsorbs to soil and mineral particles, phosphorus is lost from soils principally by soil erosion. Soil erosion can result from water runoff, wind, or lifting of soil with root crops. Soil erosion increases when fields are tilled and left without vegetation cover.
- **maintaining soil quality**: this is important if P is to be used efficiently by crop plants. Soil quality can be improved by returning crop residues and organic matter to soils, ensuring optimal pH; improving soil structure …
- **improving fertiliser recommendations and adjusting overall crop P inputs to outputs**: although on average European soils and fertiliser application rates may suggest a P surplus, there may still be a need to provide readily available phosphorus to annual crops, particularly young plants which cannot yet access soil P reserves. For this, fertilisers in forms which enable targeted delivery, close to the plants roots, and over the appropriate time, can improve PUE.
- **improving crop genotypes and promoting mycorrhiza (fungi):** developing crop varieties with longer or more branched roots can enable more effective use of P in the soil, particularly for annual crops. P uptake can also be improved by symbiosis with beneficial arbuscular mycorrhizal (AM) fungi, but with an energy cost for the crop plant.
- **lower phytic acid content crops**: see Lott et al. in SCOPE Newsletter n° 77.
- **appropriate manure management**: in regions with high densities of livestock, manure is often spread at levels higher than crop P requirements (editors' note: the same is sometimes true for sewage biosolids around urbanised areas). Systems need to be developed to export from these regions the excess phosphorus, by P-recovery or production of transportable forms such as dry granules.
- **adjusting livestock diets**: improved PUE in livestock production, and correspondingly lower P contents of manures (and so lower P losses) can be achieved by adjusting P in diets to animals' needs, or by using phytase enzymes.

The authors discuss the implications of improving phosphorus use efficiency (PUE) in farming, noting that **this may improve but will not resolve phosphorus pollution problems from agriculture**, they discuss PUE in organic or extensive agriculture, and also look at possible economic incentives to improve PUE.

Global potential for P-recovery and recycling

Mihelcic et al. assess the world potential for recycling phosphorus from human urine and faeces, and in particular in urine from which phosphorus can be more readily recovered. This is only a part of the potential resource for P-recovery, because larger quantities of phosphorus are found in animal manures.

The study estimates human phosphorus excretion from dietary protein content and population, and then estimates the proportion of population connected to centralised sewage collection systems for different continents. It is concluded that the phosphorus in the human world population's urine is c 1.7 million tonnes, that is **around 22% of global phosphorus demand (plus a similar amount in faeces).**

Gaxiola et al. present genetic engineering work underway to develop plants with increased capacity to uptake soil phosphorus. Various authors have suggested that phosphorus uptake can be increased by over expression of certain genes, for example the inorganic phosphate transport gene Pht1:1, overproduction of citrates, or with transgenic introduction of phytase genes from other species. This paper particularly looks at work on transgenic introduction ofAVP1 genes (proton-translocating pyrophosphatases: type 1 H+ PPase), which showed in several plant species to result in enhanced root systems and increased soil acidification capacity near roots, enabling increased growth and yield in low soil phosphorus conditions. This genetic manipulation can also improve resistance to drought and salt tolerance.

Rittmann et al. note that the main losses of phosphorus in today's use system are in agricultural runoff and soil erosion (46%) and in animal wastes (40%), and that **this manure loss represents a major potential for P-recovery and P-recycling**. Different possible routes and processes for phosphorus recycling from animal manures are summarised, including struvite precipitation, adsorption to different materials, ion exchange and biological uptake processes (eg. fixing by photosynthetic bacteria or algae grown on substrates, algae which secrete phosphate-binding proteins PstS).

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Toulouse France

Innovation conference: phosphorus recovery and reuse

The conference on recycling and reuse of phosphorus organised in Toulouse, France, 23rd November 2011, brought together scientists, industry, water companies and a range of organisations and experts from agriculture. The Cemagref (Rennes) and Toulouse University/ INSA are coordinating several projects on phosphate recovery, ranging from struvite chemistry through to practical applications in animal manure treatment. Alongside centres of competence in wastewater management, the Midi-Pyrénées and Brittany Region appear leading France towards phosphorus stewardship and P-recycling. The conference included presentations of P-recovery experimentation and pilot processes from scientists, innovation SMEs and the water industry (CIRSEE – Suez Environment).

Chris Thornton, for the **phosphate industry**, opened the conference, with **Thermphos International**, **Prayon** and **Tesserlando** also present.

He presented the issues around phosphate resource supply: **a non-renewable resource, for which the extent of reserves is debated, but with certain issues of increasing cost, decreasing quality, and geopolitical pressures.** Reducing and optimising phosphorus use, re-use and recovery and recycling, are thus necessary for a sustainability, as is increasing now recognised at the international and European level, and with initiatives in a number of countries.

PhosphOR process

Marie-Line Daumer (Cemagref), Angela Manas and Mathieu Spérandio (LISBP-INSA Toulouse) and Sandra Rodière (Valbio) presented processes under development and testing to recovery phosphorus from animal manures or dairy food processing effluents, as part of integrated treatment, including making available and soluble the phosphorus in the solid fraction of wastes, (using formic acid) then either precipitating as struvite (chemical process) or accumulating phosphate in micro-organism particles (biologically driven process, with phosphate forming mainly as calcium phosphate, initially amorphous with progressive phase change to hydroxyapatite).

The project to date includes **three pilot reactors:** 17 litres, 300 litres and 1000 litres, with a 150 m^3 reactor planned for 2013, with work both on swine manure streams and on cheese production wastewaters.

Further information PhosphOR :
https://phosphor.cemagref.fr/

Aurélie Capdevielle (Cemagref) and Mathieu Spérandio (INSA Toulouse) presented laboratory studies and modelling work addressing the chemistry of struvite and apatite precipitation. The experimental work suggests that to obtain large struvite crystals, ammonium should be in ionic excess, whereas magnesium and pH increase are limited by the low solubility of magnesium oxide. The physico-chemical modelling work aims to develop predictive tools, based on concentrations of the various ions present in wastewaters and on operating conditions, to enable operators of struvite recovery processes to limit nuisance deposits in reactors and elsewhere in processes, to optimise precipitation localisation and the form of phosphate precipitated.

A second stage of modelling is currently being developed to include biological processes and predict micro-organism phosphate particles.

Aeration and struvite precipitation

The experimental and modelling work both suggest the need to further examine the impact of aeration used for mixing or carbon dioxide stripping (to increase pH) in struvite precipitation systems. **Aeration also removes ammonium, which decreases the Mg-P-NH_4 ionic saturation**, and can thus cause struvite to redissolve.

Results from experiments on both pig manure and dairy wastewater indicate the need of a better understanding and prediction of calcium phosphate co-precipitation with the struvite crystals.

Suez Environment P-recovery projects

Samuel Martin of CIRSEE – Suez Environment presented processes currently under evaluation for phosphate recovery from both large and small sewage treatment plants.

At the Strasbourg municipal waste water treatment plant (1 million person equivalent), Suez and Ostara are testing struvite recovery from the anaerobic sludge digester return stream in a 120 litre/hour pilot installation. The sewage works operates secondary chemical phosphate removal by aluminium dosing, and this digester treats the secondary biological sludges only. The plant currently has to add deposit inhibiting chemicals. Suez estimate that **full-scale installation of the struvite process at the plant would enable recovery of 300 tonnes of struvite per year**.

Samuel Martin also presented a process being tested by Suez Environment to ensure phosphate removal and recover phosphates in small sewage works operating **reed bed tertiary finishing (MAREVAP Rhodanos** project**).** These biological systems are not effective phosphorus removal, except initially after set up before the substrate becomes saturated with phosphorus. The proposed system uses phosphate rock in the substrate to remove phosphate, initially be adsorption and then progressively by calcium phosphate precipitation.

It is suggested that the phosphorus enriched phosphate rock could then be recycled as a fertiliser.

Four 1.5 m^2 (150 – 500 l/j) pilot beds have been tested at Bagnols, a 10 m^2 (1-10 m^3/day) pilot at Evieu, and 1000 m^2 bed (5 – 100 m^3) bed at Monampteuil. Results suggest around 80% P-removal over the first year of operation (adsorption) and around 60% P-removal after that (precipitation), compared to only c. 15% P-removal in reed beds without the apatite substrate.

Waste and fertiliser regulations

Isabelle Robin (Evalor) presented the regulatory context for reuse of recovered phosphates from waste streams. A number of different legislations are applicable, resulting in complexity, uncertainty and possible obstacles to certain P-recycling routes. Phosphate containing products from municipal wastewaters or manures can fall under both **biosolids spreading constraints** (agronomic land loading plans, requirements for control of various product parameters) and under **fertiliser regulations** (French standards, European Fertiliser Directive requirements: requiring registration, homologation and control as specific products, with defined and reliably constant properties, specified uses and proven agronomic value). Additionally, phosphate recovered from animal manures are subject to the **European Regulation 1774/2002 (animal by-products not intended for human consumption)** requiring that human health safety must be demonstrated and the production process specified and the production site registered.

Agricultural phosphorus use

Sylvaine Berger (Solagro) presented the phosphorus status of farmland and recent trends in phosphate fertiliser use in France. Much of France's farmland is poor in phosphorus, and current phosphate doses are inadequate. On average, farmers currently are applying phosphate fertiliser only once every two years, but doses remain on average (c. 24 kgP_2O_5/ha/year) higher than national agronomic recommendations (Comifer). Fertilisers are around 8.5% of farmers operating costs.

Monique Lineres (INRA) presented laboratory scale rye-grass experimental work assessing the availability of phosphorus in different forms (mineral fertiliser, manure biosolids, biosolids from sewage works with or without iron dosing chemical P-removal). Phosphate ions of a P deficient soil were labelled with radioactive ^{32}P before mixing it with the studied organic wastes. Instead of looking at how much additional growth or phosphorus uptake was enabled by the different products, a ratio was calculated comparing uptake from added phosphorus to uptake of phosphorus already present in the soil. For the various organic wastes tested, this P availability ratio of reached more than 80% of that of a water soluble phosphate-enriched fertiliser. The authors conclude that, in the long term, it is probable that the totality of P applied contributes effectively to the soil fertility.

Cédric Cabanes (Agronutrition) indicated perspectives for developing bioengineering approaches for improving plant accessibility to the stocks of phosphorus in soil, for example by cultivating microbe strains capable of accessing and releasing phosphorus in soils.

Exchanges with the farming profession and fertiliser distributors

A round table discussion with farmers' and fertiliser distributors' representatives **Anne-Paulhe Massol** (Arterris, regional farmers' cooperative distributor of fertilisers and other agricultural supplies), **Emmanuel Alonso** (Chamber of Agriculture) and **Gérard Parghade** (farmer and administrator of the Frc2A farmers' cooperative and distributor), and with **Régis Baberian** (Midi-Pyrénées Innovation) and **Thierry Véronèse** (Agrimip – regional innovation centre for agro-industries), discussed the **conditions under which fertiliser distributors could accept and sell recovered phosphates and farmers use them.**

The distributors want a product which is easy to handle and store (clean, dry, no smell, no dust, no storage problems) and with a reliable granule size of 2-3 mm, with reliable nutrient content specifications, and free of heavy metals.

Participants replied that heavy metals have shown to be low in recovered phosphates whenever tested, and can be expected to be significantly lower than in mineral fertilisers from phosphate rock.

The farmers' representatives emphasised that recovered phosphates **should not result in an increase in soil pH,** which is undesirable on most agricultural soils, and expressed concern that the regulatory context and homologation issues should be completely clear.

Discussions showed differing approach, depending on crop and farm environmental context, between the desire to have **fertilisers with precise specifications**, enabling precision fertilisation and delivery of nutrients exactly next to the plant roots (e.g. granules with polymer coatings to enable targeted nutrient release over time), and the **use of biosolids with environmental and nutrient management through spreading plans**. The farmers' representatives indicated that this can be part of a move towards **nurturing soils as living systems, including organic content and biological functions**, and not simply a managed balance of minerals. Participants suggested that recovered phosphates should target this type of agricultural use, and that their processing into high-tech precision fertilisers, though possible would not be economic or logistically feasible.

Participants and farmers' representatives agreed that **nitrate and phosphate fertilisation generally require very different approaches**: nitrates will be lost to surface or ground water if not rapidly taken up by crops (so that precision fertiliser application is important) whereas phosphates will be stored in the soil, so that phosphate application can be managed over time with less concern about precision application, although for some crops it is advantageous to apply readily available phosphorus at times of key plant development.

It was agreed that **sewage biosolids reuse, as processed sludge or compost, is the optimal route for recycling phosphorus, wherever possible**, but that in some circumstances it is not feasible (e.g. large cities) and that the future remains very uncertain because both of contaminants (heavy metals, organics, pharmaceuticals, …) and of public perception.

Discussion of the quantities of phosphate which could reasonably be recovered from waste streams for recycling concluded that this could in the long term be **significant compared to fertiliser use** (e.g. around one third, including phosphate reuse in biosolids) but that **production will always be local and small scale** compared to the bulk volumes and centralised operation of the fertiliser industry. Regional distribution of recovered phosphate products, as a function of local source and local agriculture is thus important.

Chris Thornton concluded by thanking Midi-Pyrénées Innovation and INSA Toulouse for the organisation of this seminar and the quality of the participants, in particular for the exchanges with farmers and fertiliser distributors because **ensuring that recovered phosphates corresponds to users' needs is a key to closing the loop for phosphorus**.

He underlined that **P-recycling is complex, necessarily involving actors from the water and waste industries, farming, fertiliser production and distribution, authorities and regulators, scientists and technical innovation supplier SMEs, as well as public acceptance.**

Phosphorus stewardship is a global sustainability issue, but as the discussions showed, requires a **regional approach**, taking into account local secondary sources, distribution circuits and markets, and agricultural potential. The phosphate industry he represents is committed to promoting and implementing P-recovery and P-recycling as part of a sustainable future for society.

"Phosphorus Seminar: Recycling and use of phosphorus from waste streams, solutions to the depletion of natural resources". 23rd November 2011, Toulouse, France (Midi-Pyrénées Innovation, Cemagref, LISBP-INSA): http://www.mp-i.fr/2011/07/20/seminaire-phosphore-le-mercredi-23-novembre-a-linsa/

Seminar presentations are available online (in French) at: http://www.mp-i.fr/ *(click: "Participer aux journées" then "Retour sur les journées")*

Or: http://www.mp-i.fr/2011/12/07/retour-sur-le-seminaire-phosphore/

Other news

Analysis kit

Phosphate analysis on site

The *enalyse* phosphate analysis kit, developed by *envolure*, enables immediate analysis of soluble phosphorus concentrations in wastewaters and industrial liquors in the ranges 3 – 86 mgP-PO_4/l (Higher Range) or 15-350 µgP-PO_4/l (Lower Range).

The kit is delivered as a microplate of 96 small cells, each enabling one analysis. The liquor to be tested is added to the cell, which changes colour. **A specific reader linked to a laptop computer analyses the colour change**, by 450 nm absorbance, and derives the phosphate concentration. The kit requires virtually no laboratory equipment or training, and can be used on site at industrial, waste water treatment or agricultural installations.

The system was **specifically developed to support work on phosphate recovery** by struvite precipitation, where the developers needed rapid analysis of phosphate concentrations in the reactor inflow and outflow every few hours, in order to adjust the reactor operating parameters. It is also adapted to a range of processes involving phosphates, including managing phosphorus removal, digesters or other waste water treatment parameters.

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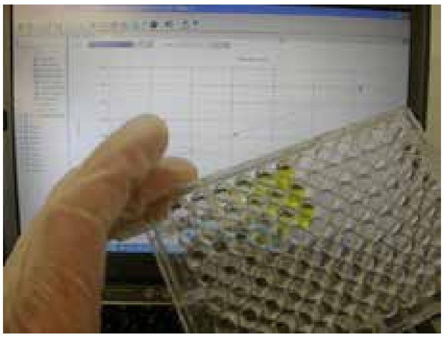

P losses

Food Waste

The EU Parliament Agriculture Committee has voted a resolution calling for action to cut by half the level of food waste in the EU by 2025. At present, nearly 50% of edible food gets wasted in EU households and supermarkets.

The Committee suggests that foods should have a double date system, with both “sell by” and “eat by” dates, that foods should be packaged in more varied sizes to enable purchase of the quantities really needed, that packaging should be improved to improve food conservation, and that past sell-by date or damaged food should be sold at discounted prices not destroyed. Public procurement rules should be modified to ensure that suppliers of canteens use local produce, and redistribute left-over food to needy populations or food banks, rather than disposing of it.

The EU Commission has announced a **policy paper on sustainable food in 2013**.

The UK has issues updated guidance on food labelling, specifying that foods should carry only a “use by” or “best before” date, and that “sell by” or “display until” labels (used by shops for stock rotation) should be removed, because these can confuse the customer.

At present, **some UK£ 12 billion of good food ends up in waste every year in Britain**, and at least 60% of this waste is estimated by the UK Government to be avoidable: that is 5.3 million tonnes of edible food per year, or UK680 for a household with children.

The UK guidance specifies that for most foods, a “best before” label should be used. The “use by” label should only be used where food may be unsafe after the given date, for example soft cheese, ready prepared meals and smoked fish. Most other foods such as biscuits, jams, pickles and tinned foods should have a “best before” label.

Further information on food waste can be found in Tristram Stuart’s book “Waste, uncovering the global food scandal”, **see SCOPE Newsletter n° 81**.

EU Parliament press release (Agriculture, 23/11/2011): http://www.europarl.europa.eu/en/pressroom/content/20111121IPR31961/html/Urgent-call-to-reduce-food-waste-in-the-EU

UK Guidance to the Application of Date Marks to Food : http://www.defra.gov.uk/food-farm/food/labelling/

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The 2-yearly conference for the worldwide phosphate industry (rock production, fertiliser, animal feeds, food, detergents, other industrial uses) will take place in El-Jadida, Morocoo, 19th - 21st March 2012.

- Phosphate rock production and project developments
- Global fertilizer outlook with a focus on key country demand projections and requirements
- Developments in optimizing / streamlining and maximizing the phosphate resource
- Survey of changing industrial phosphate demand, update of regulations and substitutes
- Outlook of future feed phosphate demand and focus on regional growth

The event also offers **site visits to the Jorf Lasfar Chemical Facility and to the Khourlbga Mine Facility**.

http://www.crugroup.com/events/phosphates/

Phosphorus stewardship conference

3rd sustainable phosphorus summit

The 3rd Summit (29th February – 2nd March 2012, Sydney, Australia) will bring together key international science, policy and industry stakeholders from different parts of the food production and consumption chain concerned about the role of phosphorus availability and accessibility in global food security, about protecting the environment, and about supporting rural and urban livelihoods.

Themes include:

- Sustainable food systems
- Global phosphate rock production and reserves
- Phosphorus use efficiency in mining, agriculture, food processing
- Phosphorus recovery and reuse
- Phosphorus pollution and waste
- Sustainable phosphorus strategies and global governance

29th February – 2nd March 2012, Sydney, Australia
http://sustainablepsummit.net/