

Press release, September 28, 2016: Latest news from phosphorus research

The challenges of phosphorus – International IPW8 Conference in Rostock identifies solutions

From September 12 to 16, 2016, the 8th International Phosphorus Workshop (IPW8), entitled "Phosphorus 2020: Challenges for synthesis, agriculture, and ecosystems", took place in Rostock. 230 scientists from around the world discussed possible solutions arising from their latest research regarding the responsible use of this finite raw material. The aim is to avoid serious damage to the environment, such as the eutrophication of water bodies, and to ensure that, through its sustainable use, there will be enough phosphorus to maintain the world's food supply in the future.

According to IPW8 participants, the most important **results** of phosphorus research in recent years include those related to the following aspects:

1. Phosphate fertilizers and inputs into water bodies: The latest research continues to show that large amounts of phosphorus still end up in water. The binding water protection objectives set by various guidelines will therefore not be reached. As an important reason, the researchers cited the persisting inefficient use of phosphorus in intensive farming and the inability of traditional agricultural soil testing of plant-available phosphorus to adequately assess the risk of phosphorus seepage. In addition, it was demonstrated that established water protection measures (for example, reduced fertilization) have yet to show success because of the long delays until the phosphorus is transported from the soil into water. It was also demonstrated that more extreme precipitation events due to climate change promote the mobilization and leaching of phosphorus.

2. Improved investigation methods: In recent years, the refinement of numerous analytical methods has allowed environmental monitoring of the presence of a large number of phosphorus compounds, for example, the weed-killer glyphosate, and their reaction products. Research methods already include the use of very sophisticated spectroscopic and isotope techniques as well as particle accelerators to carry out very detailed investigations of phosphorus compounds and their transformations.

3. Phosphorus recycling and synthesis: For the first time, the various technologies for phosphorus recycling and phosphorus-based chemical catalysis, as forward-looking strategies for the sustainable use of phosphorus, were discussed in the context of an IPW. Both fundamental, new reaction pathways and connections as well as a variety of mature technologies were presented, with phosphorus recovery from sewage sludge, slaughterhouse waste or biogas digestate as important targets.
4. Genetic research approaches: As our understanding of the genetic basis of phosphorus utilization by microorganisms, plants, and animals continually improves, new possibilities and processes related to phosphorus uptake, utilization, and dispersion are opening up. Examples are the identification of gene variants for the breeding of pigs such that they utilize the phosphorus in their feed more effectively, or new feed supplements and feeding regimes that increase the digestibility and utilization of P compounds by animals.

Important **research goals and call for action** identified by the IPW8 participants were:

1. Integrated system-based research: So far too little is known about the similarities and differences exhibited by phosphorus transformation processes in various environmental systems, such as in water or on land, and how they are coupled with Earth's other biogeochemical cycles, including those of carbon and nitrogen. In addition, there is little integrated research into the relationship between phosphorus reactions at different size scales, from individual cells to organisms to entire ecosystems. This is important because most ecosystems processes are coupled and can therefore be properly understood only through a holistic approach.
2. The translation of innovative methodologies into applications: Both in the area of phosphorus recovery as well as with respect to analytical methods for the detection of plant-available phosphorus in agricultural soils — both of which are an important prerequisites for the efficient use of fertilizers — major scientific and technological progress has been made. Yet so far widespread practical application of these technologies is lacking. Among the many different reasons are that either the practical application stage has yet to reach maturity or there are legal obstacles, such as those related to guidelines and regulations, that did not foresee the use of certain procedures. The problems partly lie in the unclear political conditions, such as revision of the Sewage Sludge Ordinance in Germany and European requirements for the recycling of manure. Here the IPW8 researchers recognize the need for action in research as well as in politics.

3. Encourage an awareness and a constant rethinking of problems:

A new perspective for the IPW was the inclusion of ethical as well as legal- and political-environmental issues affecting the use of phosphorus. Various aspects, such as the benefits of a balanced diet in the light of phosphorus availability and load or the ability to effectively control phosphorus use through incentives or bans were lively topics of discussion at the conference. It became clear that the biological and agricultural research approaches pursued almost exclusively thus far must now be complemented by social science approaches aimed at making the sustainable use and recovery of phosphorus, via its more environmentally mindful utilization, an accepted practice.

Conclusion: The participants agreed that only a wide range of individual measures implemented "in concert," such as advances in breeding methods, improved agricultural analyses and management measures, new techniques and technologies for the conservation and recovery of phosphorus, new societal norms, greater consumer awareness and complementary policy programs can solve the phosphorus problem. This joint strategy requires the development of new academic structures, such as the Leibniz ScienceCampi, that support the transfer of technologies, methodologies, and ideas.

The **International Phosphorus Workshop (IPW)** takes place every three years in different European countries and is one of the most important events in the field of phosphorus research in Europe. This year, for the first time, Germany was the host and was able to welcome a record number of participants. The workshop organizer was the Leibniz ScienceCampus Phosphorus Research Rostock, a consortium of five Leibniz institutes, and the University of Rostock.

IPW Chairs:

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Leibniz ScienceCampus Phosphorus Research Rostock

Because of the central importance of phosphorus in many production and environmental systems, an interdisciplinary research approach is necessary. Therefore, five Leibniz Institutes and the University of Rostock have joined to form a network to intensify joint research and other forms of cooperation regarding this essential element and its sustainable management. The Leibniz ScienceCampus Phosphorus Research Rostock promotes, as part of its strategic research, interdisciplinarity in its topics, projects and methods. Established fields of expertise in various aspects of the exploration of the essential element P, its different chemical compounds and reactions, and its specific modes of action in agricultural and environmental systems as well as in technical and industrial processes are combined at the ScienceCampus. The ScienceCampus is funded by the Leibniz Association and the Ministry of Agriculture, Environment, and Consumer Protection Mecklenburg-Vorpommern.