

Protecting the Phosphorus Resource by Phosphorus Recycling in Wastewater Treatment Plants

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As early as 1972 MEADOWS et al. published their study "The Limits to Growth" on the future of the world economy, which was updated last in 2004 as "Limits to Growth: The 30-year Update". In this study, which has been the topic of much controversy, the authors concluded that raw materials have been used excessively since 1980. The threatening grave ecological ramifications could only be lessened by drastically reducing the use of resources, thus preventing the collapse of the ecosystem. Therefore, closing raw material flow cycles in order to preserve global resources takes on a central significance.

In the recent past, phosphorus resources and utilisation have increasingly become the focus of scientific attention, since phosphorus can be regarded as a scarce resource today. Phosphorus demand is stagnating in industrialised countries, but in emerging economies and developing countries, it is increasing with the constant rise in population and with the enormous economic growth in certain countries such as China and India. In order to cover global phosphorus demand, approx. 130 million Mg of phosphate rock is mined annually. The production is concentrated in only a few countries, based on geological conditions (Figure 1). Germany and also the other European countries do not have any phosphate ore deposits and are, therefore, dependent upon the import of phosphates. For the fertiliser industry, which requires 80 % of phosphorus produced world-wide, there is no phosphate substitute that would make the utilisation of raw phosphates dispensable. Therefore, the importance of recycling phosphorus has grown significantly.

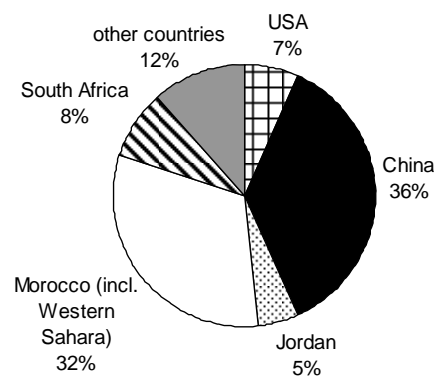


Figure 1: Global allocation of the phosphate reserves (USGS, 2008)

Procedures to recover phosphorus from wastewater, sewage sludge and sewage sludge ash exist and there are several points at which phosphorus recovery systems can be integrated into or added to the individual stages of municipal wastewater and sewage sludge treatment. There are, in principle, four such points: recovery from wastewater treatment plant effluent, from sludge waters, from dewatered sewage sludge and from sewage sludge ash. Different processes exist for each of these materials, of which only few have been implemented on a large scale. All the other processes have only been tested on a laboratory or pilot plant scale and require further research and development. Many of the processes are characterised by complex and thus extensive process engineering, which often has to be installed completely anew as an additional procedural step. This higher effort also means higher demands upon the operating personnel. In addition, the need for chemicals to recover phosphorus must also be seen as very high in certain processes. A large part of the processes generate products that can be supplied to the phosphorus industry as well as directly utilised in agriculture, or at least this is said to be possible by their developers. Investigations often have yet to be conducted with regard to the plant availability of these secondary phosphates. An estimate of the recycling potential indicates that the multitude of possibilities of recovering phosphorus from wastewater, sewage sludge and ashes have a theoretical substitution potential of 17% up to 40%, with respect to current mineral fertiliser use in Germany.

Up until now, only very small revenues can be attained for the sale of secondary phosphates, of the order of EURO 100/Mg of product (for MAP), or approx. EURO 1/kg P. Phosphorus recycling that covers all costs is thus not currently possible without financial support. But it is to be expected that the world market price of phosphate ores will rise because the amount of high quality resources is sinking and the usage of phosphorus is growing. Actually, this has already happened during the last months. The technology necessary for phosphorus recycling is new, and significant reductions of the investment costs are possible as the process undergoes further innovation and optimisation.

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