

Course title: Cleaner production and innovations in phosphorus compounds industry – ~~selectable~~ / regular course

Number of contact hours: 30 hours (15h seminar, 15h laboratories)

ETCS credits: 2

Course description: characteristic of phosphorus industry, raw materials, main technologies. Cleaner Innovations in technology of phosphorus compounds: wastewater streams, secondary raw materials, waste streams. Technological examples of phosphorus compounds production directly on wastewater treatment plants (DHV Crystalactor, Rearl, NuReSys, PHOSPAQ, ANPHOS, STRUVIA).

Phosphorus compounds production from secondary raw materials: sewage sludge, sewage sludge ash, meat-bone meal etc. (Krepro, LYSOGEST, GIFHORN, MEPHREC, Budheim, LECHPHOS, ECOPHOS, THERMPHOS, AshDec)

Comparison and critical review.

Laboratories: Phosphate Fertilizers from sewage sludge ash- technical scale installation

1st Part – all teams of students parallel

- Calculation of the proper amount of the ash for the extraction according to the provided elemental analysis
- Preparing of the WPA (wet phosphoric acid) solution (one solution for all teams) in 30 liters container
- Sampling of the WPA solution for analysis
- Loading of the ash to the storage funnel and pumping of the acid solution to the reactor
- Extraction process parameters monitoring (pH value, temperature)
- Sampling of the suspension during the process – phosphorus concentration changes analysis
- Suspension separation, product collection and washing of the cake
- Sampling of the solutions for further analysis
- Water content determination in the cake

2nd Part

- Phosphorus determination in the solutions– spectrophotometric method (SPECORD Analytik Jena)
- Extract neutralization with ammonia solution in order to obtain NP-type fertilizer
- Pellets of the fertilizer preparation
- Extract neutralization with lime (pH value 6) in order to obtain P(Ca)-type fertilizer
- Granules preparation

3rd Part

- Fertilizer analysis – phosphorus content (total, water-soluble, soluble in ammonium citrate and/or nitrogen content (N_{NH_4}))

Education effects (P6S_UW P7S_UW, P7S_WG):

- **knowledge:** student knows characteristic of phosphorus compounds industry and developed cleaner production processes; are aware of problems with raw materials and environment pollutions caused by phosphorus industry; students knows innovative technologies of phosphorus compounds production from secondary raw materials or wastewater streams- its advantages and disadvantages.

- **skills:** student can obtain and analyze fertilizers form secondary raw materials, can operate technical installations equipped with industrial probes and measurements (50l reactors, stirrers, pumps, ph-meters); can calculate, prepare the balance the process.

- **social:** student understands the reason and benefits of using cleaner production and innovation in phosphorus industry; understand the reason of using innovative technologies; understand the threats connected with using secondary raw materials in technology; is able to work independently and in the group both at the laboratories and during preparation of the report

Literature: 1. Phosphorus platform, 2. International Fertilizers Industry Association

Assessment method: presentation of selected topics, completing the laboratories (presence and delivering of reports from performed exercise)

Prerequisites: Basic knowledge in chemistry and technology

Primary target group: All specialties students

Lecturer: dr inż. K.Gorazda, dr inż. B.Tarko

Contact person: dr inż. K.Gorazda e-mail: gorazda@chemia.pk.edu.pl