PARFORCE-process

Results of trials with sewage sludge ash of Emscher-Lippe-Region

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The PARFORCE-Technology principle
Gaining P-acid from a variety of primary & secondary resources containing P

Leaching with HCl or HNO₃

Electro- dialysis for purification

Concentration with vacuum evaporator

Fe/Al elimination

Neutralisation of salt solution

Liquid-solid separation

Liquid-solid separation

Road salt (HCl-route)
Ca(NO₃)₂ (HNO₃-route)

The 4 steps of PARFORCE-Core

Additional process steps for SSA

Alternative materials for processing:
• Struvite
• Di/tri-calcium phosphates
• Bone meal ash
• Rock phosphates (apatite)
Processing a blend of ash from 3 different incineration plants
Task: producing high quality P-acid from challenging sewage sludge ash

Unfavourable SSA: low P content and high concentration of impurities
- Blend contained only 5.3% P in DM and 7.4% Ca
- Ratio (Fe+Al)/P above 3
- High concentration of heavy metals (especially Pb, Ni, Zn)

- SSA from IP 3 shows average composition of incinerated municipal sewage sludge
- SSA 1 + 2 show far more unfavourable composition than average
- All ash samples showed in at least one HM parameter limit exceedance
- None are suitable for use as or in fertilizer according to German Fertilizer Act
Purification of crude P-acid from leaching liquor

Demonstration trials showed even better results than laboratory trials

Change in concentration of elements

Removal of impurities in electro-dialysis from leaching liquor after Fe/AL-separation (core process step):

- Increase in P concentration due to hydrate shell transportation
- Decrease in concentration of leached impurities:
  - Ca, Mg, K: >> 90%
  - Fe: 87%
  - Al: 47%
  - HM: most below detection level (< 5 ppm)
  - Cu: 94% (< 7 ppm)
  - Zn: 98% (< 6 ppm)

P recovery rate way above legal requirement of 80% (actual transformation into product)

- Reliable mass balance
- Purity $H_3PO_4$: 88.5%; increase to 99.7% with simple measures after ED shown (mainly decrease in Al)
- By-product: road salt meeting strict requirements
Conclusions

- Scale up trials in PEC’s Demonstration plant showed even better results than laboratory tests due to higher masses processed and better use of capacities.
- PARFORCE is suitable to meet upcoming German legal P-recovery requirement for even the most challenging SSA.
- Unfavourable composition of SSA of Emscher-Lippe-Region poses no problem for PARFORCE:
  - >> 80% recovery rate, minimum purity of P-acid 88.5%
  - Increase of purity of P-acid up to 99.7% with simple measures demonstrated
  - By-product: road salt meets all requirements for marketing.
- Trials delivered consistent mass balances and allowed reliable cost estimates.
Project responsibilities at PEC

PARFORCE Engineering & Consulting GmbH
Am-St.-Niclas-Schacht 13
09599 Freiberg

Project leader; laboratory and demonstrator trials; analytics:
Dr. Gunther Martin
Tel.: +49 151 59 120 080
e-Mail: gunther.martin@parforce-technologie.de

Deputy Project leader; opex estimates, mass balances:
Dipl.-Kfm. Jürgen Eschment
Tel.: +49 176 66 998 168
e-Mail: juergen.eschment@parforce-technologie.de

Basic engineering; investment cost estimates:
Dr.-Ing. Reinhard Lohmeier
Tel.: +49 176 66 997 861
e-Mail: reinhard.lohmeier@parforce-technologie.de

Quality management:
Dr. Peter Fröhlich
Tel.: +49 176 41 950 732
e-Mail: peter.froehlich@parforce-technologie.de

www.parforce-technologie.de
info@parforce-technologie.de