Economic aspects of utilizing fluosilicic acid for manufacturing hydrofluoric acid and aluminium fluoride (HBD-AIF$_3$)

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Economics of FSA versus CaF2 (AGF)

- How profitable is the FSA process compared to Fluorspar process?
- At what price fluosilicic acid shall be purchased?

**FLUORSPAR PROCESS**

CaF2 ➔ HF ➔ AIF3

**FLUOSILICIC ACID PROCESS**

H2SiF6 ➔ HF ➔ AIF3

AGF: Acid Grade Fluorspar > 97% CaF2
Process HF and AlF3 from fluorspar
Process HF and AlF3 from fluosilicic acid
Process HF and AlF3 from fluosilicic acid (2)

- Simplified flowsheet
Assumptions Economics of FSA versus CaF2

- Capacity 30 kt/a AlF3, typical case
- Capacity 20 kt/a HF, typical case
- Capital cost estimated for Emerging Countries
- Plant & Utilities as required
- Prices eg raw materials, chemicals per end 2012
- Logistics for shipping overseas
- Interest rate @7.5%/a
- All assumptions for Emerging Countries

- **Economics** (function of price of AGF 97% CaF2 Min)
- **Economics** (function of price of FSA 100% H2SiF6)
Economics of HF and AlF3 from fluorspar - features

- High mining costs for fluorspar exploration, mining, concentration
- Fluorspar expensive
- Sulphuric acid & oleum are required
- End-use for anhydrite gypsum is required
- Fluorspar technology is mature, cost effective
- Plant is Standalone
- Site preferably at mine, at harbor for AlF3
- Site preferably at end-user site for AHF
Economics of HF and AlF3 from fluosilicic acid - features

- Savings of significant high mining costs
- Recovery of fluosilicic acid >~ 21%
- Technology new
- Raw material are free except ATF for AlF3 manufacture
  - Fluosilicic acid can be cheap
  - Sulphuric acid is not consumed
- Little waste – Silica is a potential product
- Chillers for cooling water included
- Plant Not Standalone as large volume of diluted sulphuric acid has to feed the Phosphoric acid plant
- Arsenic removal is required for AHF manufacture only
- AHF containment tank and fleet of ISO tank containers
Economics of hydrofluoric acid - safety

- AHF containment tank and fleet of ISO tank containers
  - Safety first -
Economics of aluminium fluoride

- Competitive advantage (absolutely) for Phosphoric Acid Producers (FSA cheap)
  - Case FSA cheap
    - (1) AGF costs (mine owner)
    - (2) AGF price in China
    - (3) AGF traded on World Market
Economics of aluminium fluoride (2)

- Competition starts with fluorspar mine owners
  - FSA medium price (FSA purchased)
    1. No advantage versus AGF mine owners (I/O China)
    2. Still advantageous versus AGF actual price in China
    3. Competitive versus AGF traded on World Market
FSA is competitive only against Producers non integrated with fluorspar

- FSA too expensive (FSA purchased)

Better to Sell FSA for water fluoridation

Fluorspar process preferred
Economics of hydrofluoric acid

- Competitive advantage only against (2) and (3) for Phosphoric Acid Producers (FSA is free)
  - FSA cheap

(1) AGF mine owner if FSA has to be treated (competition)
(2) AGF actual price in China (OK)
(3) AGF traded on World Market (OK)
Economics of hydrofluoric acid (2)

- Not competitive against fluorspar mine owners
  - FSA medium price (FSA purchased)
    (1) No advantage versus AGF from mine owner (In China or outside)
    (2) In competition with AGF in China
    (3) Competitive versus AGF traded on World Market
Economics of hydrofluoric acid (3)

- Not competitive
  - FSA too high price (FSA purchased)

  1. No advantage versus AGF from mine owner (I/O China)
  2. In competition with AGF in China
  3. Competitive versus AGF traded on World Market
Economics of HF and AlF₃ - conclusions

- Better is production of AlF₃ w or w/o HF
- FSA Capacity is an advantage
  - AlF₃ producers (AGF) non integrated are at risk
- Recommend to study in detail projects
- Locate downstream productions at fertilizer site eg HFCs
- Plan environmental units from early conceptual stage
- Alliances / JV to favor for AHF
THANK YOU VERY MUCH FOR YOUR ATTENTION

For more information, please do not hesitate to contact us!

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Process Technologies (incl. fluorine), Project Promotion (JV), Trading (ores, minerals, chemicals), ....