

BASF MINING SOLUTIONS

Phosphate flotation reagents

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Sustainable, high-performance products

The mining industry is shifting towards improving environmental sustainability. Individual companies are pursuing this objective by optimising ore recovery in a sustainable manner as well as by managing tailings more effectively. Sustainable ore recovery is being achieved by replacing or reducing the use of toxic and non-biodegradable materials, for example, and by lowering the consumption of reagents.

BASF mining solutions provides the mining industry with sustainable solutions which increase productivity, recovery and flexibility. Our expertise and capabilities cover every type of hydrometallurgical process, including leaching, solvent extraction, flotation, solid/liquid separation and tailings management. The company provides mining operators worldwide with innovative products and industry leading technical expertise backed up by global field support.

BASF supports its mining customers on their journey towards sustainability with products that meet the highest regulatory standards. These improve the sustainability of mineral extraction processes by offering innovative chemistry in combination with operational support and digital solutions.

Table 1: BASF's portfolio of collectors for phosphate flotation

Product	Application
Lupromin® FP A 369	Fatty acid formulation specific for weathered ores with presence of fine particles; biodegradable and APEO free.
Lupromin® FP A 712	Anionic collector recommended for apatite flotation where CaO/P ₂ O ₅ ratio is high; APEO free.
Lupromin® FP A 1341BW	Non-ionic modifier for direct flotation of both oxidised and un-oxidised igneous phosphate ores; biodegradable and APEO free.
Lupromin® FP A 1095B	Special carbonate selective collector for direct flotation; APEO free.
Lupromin® FP A 1210 Base	Special synthetic formulation for direct flotation of igneous silicate-contained phosphates and for reverse flotation of carbonates in sedimentary phosphates; biodegradable and APEO free.

Source: BASF Mining Solutions

In keeping with this approach, the mining solutions team at BASF continues to work intensively to develop new flotation collectors for phosphate ores. Tailored to customer needs, these reagents are designed and optimised for both direct flotation of apatite and/or reverse flotation of carbonate gangue (Table 1).

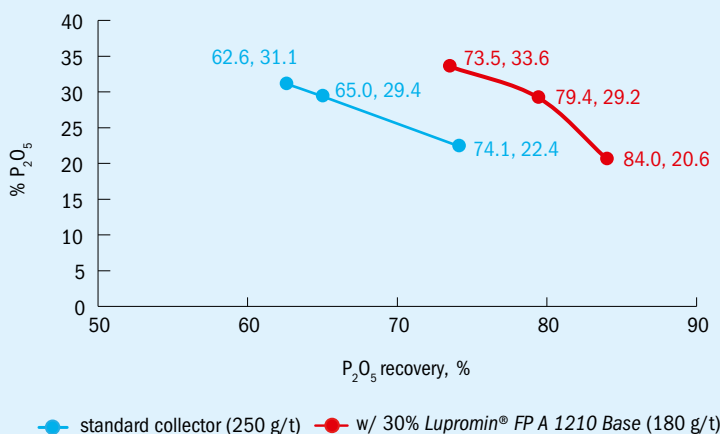
With high-grade ores diminishing, the demand for chemicals offering improved selectivity and higher recovery is correspondingly rising. Indeed, the need to continuously improve the product formulations applied in low grade and complex

ore deposits is making sustainable mining solutions essential.

BASF's Lupromin® portfolio (Table 1) offers an innovative and sustainable range of collectors, co-collectors, frothers, modifiers and flocculants. These are suitable for phosphate operations as well as the beneficiation of other ore types.

Beyond its standard portfolio, BASF also develops tailor-made formulations in close collaboration with its customers and partners. This includes support for laboratory, pilot plant and industrial test work. These customised formulations achieve

Fig. 1: Effects of BASF's Lupromin® FP A 1210 Base co-collector on grade and recovery: lab scale tests on a weathered igneous phosphate ore from South America



Source: BASF Mining Solutions



superior flotation performance due to their defined froth characteristics. They are capable of delivering yield increases of up to 10 percent at reduced dosage rates and costs – fulfilling the classic sustainability mantra of ‘doing more with less’. On top of this, BASF also provides reliable data and tools to quantify the contribution flotation reagents make to sustainability.

Enhanced flotation with co-collectors

Lupromin® FP A 1210 Base – one of BASF’s latest product developments – has been successfully applied on igneous weathered phosphate ore from a mine in South America. This co-collector product was used to boost the performance of a standard flotation reagent (NaOH-neutralized soy oil fatty acid) applied in the direct flotation of the mine’s silicate-bearing phosphate ore (4.5% P₂O₅ and 32.0% SiO₂).

Initial lab-scale flotation tests with *Lupromin® FP A 1210 Base* demonstrated significant grade and recovery improvements (Figure 1). These beneficial results were achieved due to the synergistic effect

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between the co-collector and the fatty acid collector. In recent test work on this mined ore, *Lupromin® FP A 1210 Base* delivered the following advantages:

- P₂O₅ grade remained at around 32 percent while recovery increased by six percent
- The addition of a co-collector at a dose of 10 percent allowed a 30 percent reduction in the fatty acid collector dosage
- Operational CO₂ emissions were reduced by six percent (per tonne of phosphate production) and accompanied by additional savings in energy consumption
- Tailings disposal was also lowered.

Performance gains with other collectors

In addition, BASF recently performed further flotation tests on the following two phosphate ores:

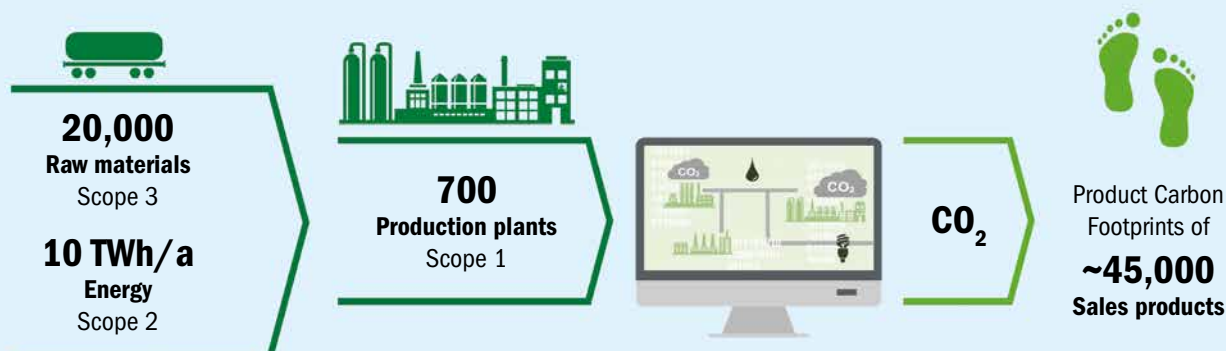
- **North European igneous phosphate ore:** direct flotation with *Lupromin® FP A 1341BW*, a non-ionic modifier resistant to temperature variations, achieved a 2.5 percent increase in recovery at a 40 percent lower dose rate, compared to the previously applied product. CO₂ emissions were also reduced by 2.5 percent (per tonne of phosphate production).
- **South American igneous phosphate ore:** direct flotation with *Lupromin® FP A 712*, a highly selective collector, increased recovery by 18 percent. This product, being a replacement for APEOs, also improved health and safety during material handling. CO₂ emissions were reduced by as much as 11 percent too, depending on the exact customer site. ■

References

1. BASF, 2020. *BASF Report 2020. Economic, environmental and social performance.* p43.

Product Carbon Footprints create transparency for customers

Digital application to calculate greenhouse gas emissions of 45,000 sales products



Cradle-to-gate Product Carbon Footprints for BASF’s portfolio available by end of 2021 based on process emissions, energy demand and upstream emissions.

Source: BASF Mining Solutions

Calculating product carbon footprints (PCFs)

As part of its commitment to sustainability, BASF plans to make available individual carbon footprints for its entire portfolio of around 45,000 sales products by the end of 2021¹. This is being achieved with the help of a new digital calculator that was developed in-house for measuring product carbon footprints (PCFs). PCFs cover all of BASF’s product-related greenhouse gas emissions that occur dur-

ing manufacturing up until the point the product leaves the factory gate for the customer: from the purchased raw material to the use of energy in production processes (Scope 1-3 emissions). Calculating PCFs creates transparency for our customers and partners, enabling us to develop plans to collectively reduce CO₂ emissions along the value chain up to the end-product. ■