



Flotation collectors

—
Maximize performance

Nouryon

Together we succeed

We believe that by combining your particular flotation process and ore knowledge with our expertise of chemical functions, we can maximize the recovery and grade of your concentrate.

With over 80 years of experience in designing mineral processing chemicals for mining applications, we are committed to finding the best flotation solution for your specific ore.

Whether you need a tailor-made or standard collector, we approach each assignment individually, assuming the role of a partner rather than a traditional supplier. Our dedicated specialists are ready to work with you to optimize your flotation process.

Towards a sustainable future

One of our core competencies is in complex chemistries which enables us to support you in making the best use of natural resources while ensuring the safe handling of our flotation collectors.

We have extensively reviewed the impact of our collector chemistry on the environment and developed analysis methods for detecting very low levels of our products in water and air. This allows us to evaluate and assess any potential changes and employ any necessary actions. We have an experienced team of toxicologists and ecotoxicologists, a world-class analytical department, and an accomplished mining team. Our goal is to deliver not just the desired functionality but improved sustainability performance as well.

Regulatory support – case description

A customer requested our support to ensure that the use of our product at their site would be safe for the environment. Since the plant had not yet been built, we were unable to take discharge water measurements and it was necessary to find another method to assess any potential impact.

Solution

Our ecotoxicology and flotation technical team worked in close collaboration with our customer to understand the different flows of the mine and set up a risk assessment plan for this unique operation. A lab flotation program was put in place to simulate a full-scale process and water samples were collected.

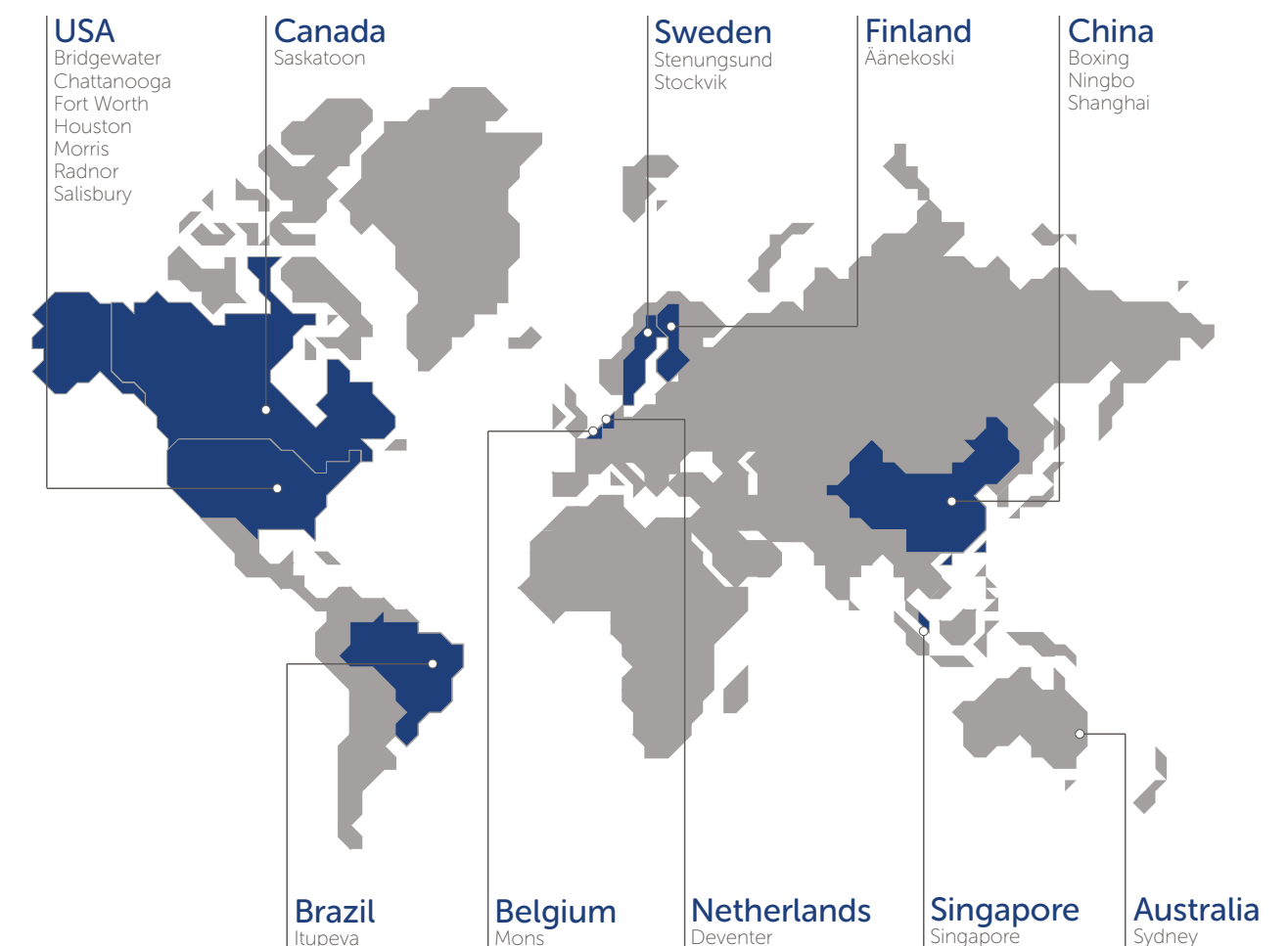
A water analysis method for detecting the level of substances down to parts per billion was developed by our analytical department and used to test the collected samples. When the predicted exposure was compared with regulatory toxicity requirements, the use of our product was deemed safe. After the plant was commissioned, additional water samples were taken which verified the earlier risk assessment.

As a leading global supplier of specialty chemicals and essential solutions with operations in over 80 countries, we offer a portfolio of industry-leading brands.

Our dedicated mining experts support customers through geographically distributed manufacturing plants, research and development centers, testing laboratories, and sales offices, as well as regional headquarters in Radnor, USA, Stenungsund, Sweden, and Shanghai, China.

We are focused on driving excellence across your value chain by delivering reliability and high product quality.

Contact us to find out how we can help you maximize performance and enhance recovery. Learn more at nouryon.com/markets/mining.



Serving a wide range of applications

How do you achieve successful flotation? By ensuring the optimal interaction of all components within a process where the flotation collector’s performance plays a key role.

Ideally, collectors should be

- Strong enough to improve recovery but weak enough to enhance selectivity
- Able to provide a high rate of flotation and good froth characteristics
- Non-sensitive to variations in the ore composition and water quality
- Designed to meet environmental requirements
- Easy to ship, store and handle
- Cost-effective

Our flotation collectors are marketed under the following brands

Armac®

Atrac®

Lilafлот®

Armeen®

Berol®

Tecflote®

Armoflote®

Ethomeen®



Mineral	Task
Phosphate/ apatite	Beneficiation of phosphate ores containing silicates or carbonates as gangue minerals
Magnetite/ hematite/itabirite	Removal of silicates and/or apatite (dephosphorization)
Potash	Removal of clays, direct flotation of sylvite, or reverse flotation of carnallite
Calcite	Removal of discoloring minerals and/or silicates
Barite Magnesite Spodumene	Reverse flotation where impurities are silicates
Feldspar Fluorspar Kaolin Pyrochlore Scheelite Silica Sulfide Wollastonite Zinc oxide	Direct flotation

Flotation of potash

Potash is the most important source of potassium in fertilizers and it is upgraded primarily through flotation methods.

We are the world-leading supplier of collectors to the potash industry which we have been serving for over 80 years. For the direct flotation of potash, we can deliver either standard amine produced from different types of fatty acids or specialty formulations. In cases where clay minerals are present in the ore, we can provide collectors for the slime flotation step needed prior to potash flotation. We also offer collectors for reverse flotation where halite is floated to beneficiate carnallite.



Case description

A potash customer using direct flotation of sylvite contacted us to help address issues during flotation and metallurgical recovery, especially in cases involving coarse sylvite. When brine temperatures rose above 30° C, the recovery started to drop, and they were unable to compensate completely by increasing dosage.

Solution

To support the customer, we designed an experiment to evaluate how temperature affected recovery as well as how different amine blends could be used to stabilize performance. As a result, we developed a new formulation that improved recovery by 4–5% at temperatures around 35° C.



For flotation of potash:

Armac®

Armoflote®

Armeen®

Ethomeen®

Flotation of phosphate

Phosphate ore is the most important source of phosphorus in fertilizers. To supply the phosphoric acid plant with phosphate, a high grade of phosphorus is essential, as well as reduced levels of impurities such as magnesium, iron and aluminum oxides.

Flotation is a key beneficiation method and the need for tailor-made solutions increases as ores become more complex. With over 40 years of experience in phosphate flotation, we have developed boosters as well as customized collectors for situations where traditional fatty acids are not optimal for direct flotation.

We have also developed direct flotation collectors that successfully float magmatic phosphate apatite from gangue minerals such as silicates and carbonates. In cases where direct flotation is not feasible, we provide carbonate and silica collectors for reverse flotation. In our laboratory, and in close collaboration with you, we can fine-tune our products to meet the requirements of your flotation feed and process.



For flotation of phosphate/apatite:
Atrac® **Berol®**

Case description

We were contacted by a phosphate company that wanted to improve its direct phosphate flotation process with silicates as the main impurities. There were extreme fluctuations in the flotation performance depending on the amount and complexity of silicates in the feed, as well as a significant drop in performance when process water temperatures dropped to below 15° C. At that time, the only available solution for improving performance at lower temperatures was heating the process water to above 15° C, resulting in high energy costs. The customer also had to constantly adjust the fatty acid dosage to deal with changes in ore quality.

Solution

To improve the robustness of the flotation process and be able to perform flotation successfully at temperatures below 15° C, an anionic booster was proposed to be added to the fatty acid currently used. Upon evaluation, it was recognized that adding the booster removed the need for heating the process water. This also reduced total collector consumption by 25% and improved recovery by 1%. With the addition of the booster, the customer was able to maintain a stable collector dosage rate while improving performance.

Flotation of iron ore

The main objective of iron ore flotation is to upgrade the concentrate by removing silicates and/or phosphorus-containing minerals.

Over the past few decades, silica flotation processes have increased, a trend that will continue as more complex ores have to be mined and the steel industry requests higher-grade iron ore concentrates with lower levels of impurities.

For more than 40 years, we have been developing flotation collectors for magnetite and hematite ores through close collaboration with our customers. By studying which froth characteristics complement traditional float tests, we have designed new methodologies and successfully progressed from lab tests to full-scale plant conditions.



Case description

An iron ore company was looking for an alternative product for silica flotation. They requested a product that would achieve the same metallurgical results as the one they were using but with improved froth characteristics.

Solution

After screening several different products with our customer, we successfully identified an alternative that both fulfilled the metallurgical results requirement and improved froth characteristics. When used for silica flotation, our product also reduced the odor in the flotation plant, benefitting the plant personnel and supporting our commitment to the safe and responsible supply of essential chemistry.



For flotation of iron ore:
Atrac® **Lilaflot®**

Flotation of calcite

Our customized collectors remove silicates and graphite from calcite, improving brightness and reducing abrasiveness.

Natural calcite deposits contain various types of silicates and graphite, but different applications require specific characteristics. For example, it is necessary for calcite to have a high level of brightness and low level of abrasive silicates for paper fillers.

Drawing on more than 45 years of experience from the field, we have developed several formulations to improve the performance of flotation collectors for calcite ores. The formulations are tailored to aspects such as flotation feed complexity and particle size. In cases where discoloring minerals are present, we offer collectors that can be used independently or in combination with silica flotation collectors.



Case description

One of our customers wanted to address a reduction in the quality of the ore feeding their flotation plant and the resulting lower recovery rates. In addition, the current collector was generating excessive froth in the flotation circuit and downstream from the flotation plant. They requested our technical support to develop a silica flotation collector to improve the reverse flotation of calcite to better suit their changing ore type and needs.

Solution

Through close collaboration with our customer, we identified the properties needed for their new silica collector. As a result, we developed and delivered a solution that improved the froth quality in the flotation plant and resolved the froth issues downstream – while maintaining the same dosage level as the previous collector. Our solution also upgraded the metallurgical results, providing 2% higher recovery at the same grade, and brought increased liquidity, reducing the customer’s production downtime in colder temperatures.

For flotation of calcite:
Armeen® **Armoflote®**
Ethomeen® **Lilaflot®**

Flotation of sulfide

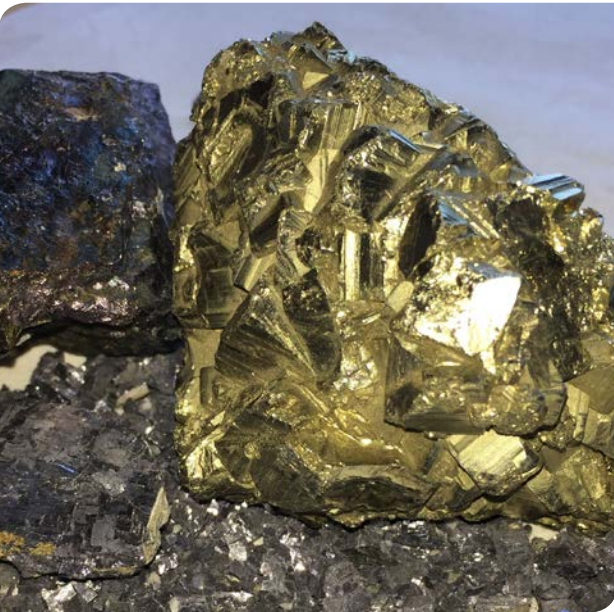
Traditional methods of flotation for sulfide ores have used xanthates, dithiocarbamates and dithiophosphates since the early 20th century. We developed the Tecflote® nitrile-based sulfide flotation agent, a novel and proprietary solution, to maximize grade.

Novel chemistry

Our Tecflote® flotation agent is designed for the flotation of sulfide ores and has several unique features when compared to conventional sulfide flotation agents, including a higher selectivity towards chalcopyrite and a strong rejection of pyrite.

Performance

Lab tests as well as plant trials have shown significantly improved performance (especially in grade) for copper, zinc, lead, and nickel. The Tecflote® agent works in most circuits and is ideal for rejecting pyrite gangue where selectivity issues are present.



Optimization

For optimal performance, the Tecflote® flotation agent should be applied in combination with other traditional collectors where the synergies of the components of the blend result in enhanced grade and recovery. We have built our world-class technical expertise over 50 years by developing and implementing flotation collectors through close customer collaboration and applying our application know-how to design the most optimal collector formulations to meet your sulfide flotation needs.



For flotation of sulfide:
Tecflote®

Delivering optimized performance

At Nouryon, we are proud to have dedicated teams to support your needs around the world.

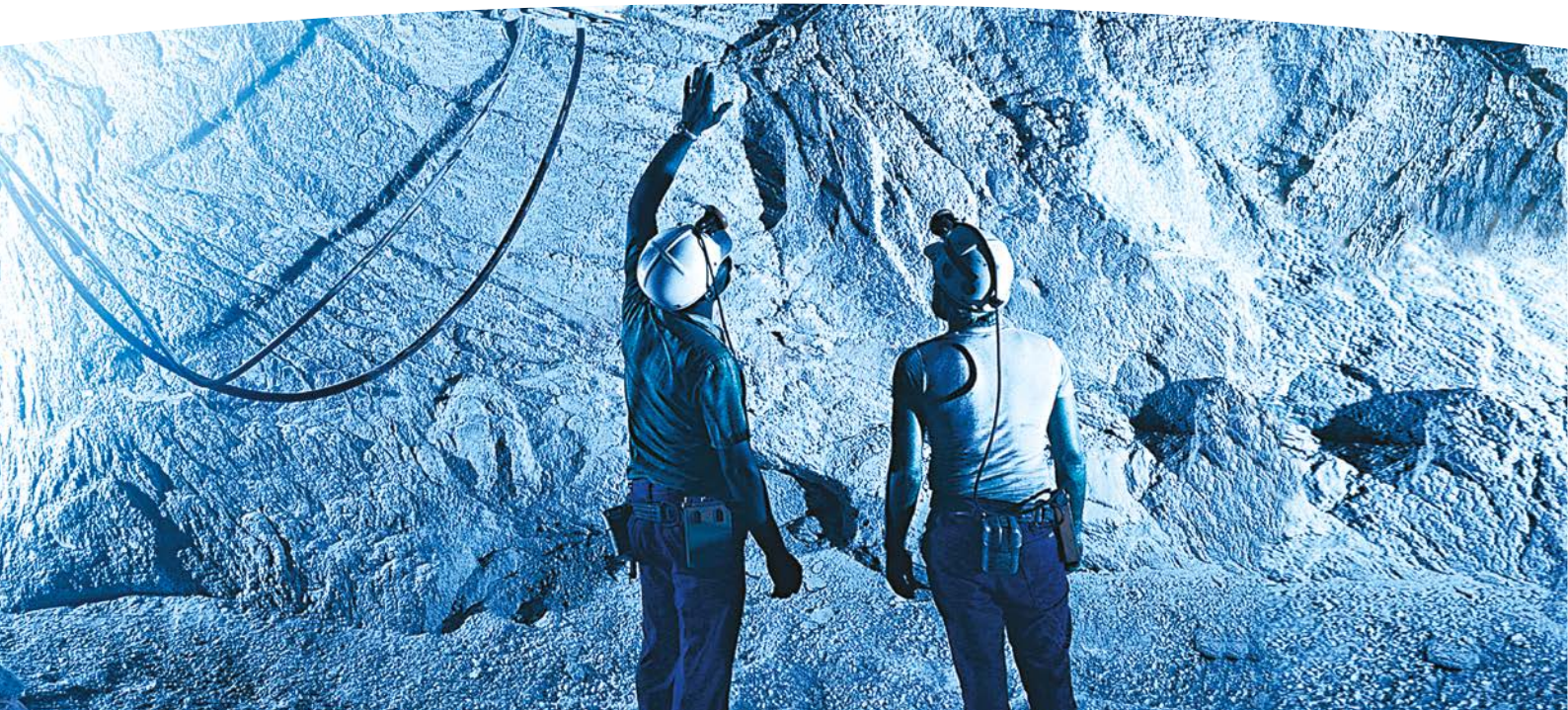
Our integrated supply chain drives excellence across the value chain by delivering reliability and high product quality. We reduce complex logistics dependency and put sustainability at the core of our operations.

With a highly experienced synthesis and analytical team and fully-equipped mining labs in Sweden, Brazil and the United States, we support you in maximizing the performance of your process.

Contact our mining experts to help you identify the optimal solution for each ore type.

Mining laboratory capabilities

- Flotation testing
- Flotation process optimization
- Ore sample characterization and preparation
- Crushing and grinding
- Froth quality characterization
- Surfactant and chemical sample analysis
- Microscopy techniques
- Synthesis department
- Experiment design and multivariate data analysis
- Risk assessments



Our history in mining

1940

First commercial use of potash collectors

1947

Armoflote®, Armac®, and Armeen® collectors launched to enhance flotation processes

1955

Ethomeen® and Berol® agents introduced for mineral flotation

1958

Flotation of silica-bearing minerals such as feldspar and mica completed

1964

Lilafлот® collectors added to mineral flotation portfolio

1974

Calcite beneficiation achieved

1979

Phosphate/apatite beneficiation completed

1981

Iron ore beneficiation achieved

1983

Atrac® collectors added to mineral flotation portfolio

2020

Removal of nonylphenols/nonylphenol ethoxylates (NP/NPE) from mining chemicals portfolio, reinforcing our commitment to be a provider of sustainable and essential chemistry solutions

From now and into the future

We are your partner in essential solutions for a sustainable future. Our strategy focuses on innovation and sustainability, our customers and end-markets, and continuous improvement. Guided by our company purpose and values, we continue to evolve our flotation chemical portfolio and deliver customized solutions through close customer collaboration.

By maximizing the performance of your mineral processing, we deliver value today, tomorrow, and well into the future so we can win together.

Contact us directly for detailed product information and sample requests
website | nouryon.com/markets/mining
email | mining@nouryon.com

Nouryon

Nouryon is a global, specialty chemicals leader. Markets and consumers worldwide rely on our essential solutions to manufacture everyday products, such as personal care, cleaning goods, paints and coatings, agriculture and food, pharmaceuticals, and building products. Furthermore, the dedication of more than 7,900 employees with a shared commitment to our customers, business growth, safety, sustainability and innovation has resulted in a consistently strong financial performance. We operate in over 80 countries around the world with a portfolio of industry-leading brands. Visit our website and follow us @Nouryon and on LinkedIn.

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