Technology Capabilities

To meet the increasing market demands within the mining industry, Huntsman recently invested in its mining laboratory facilities around the world. At these sites in Australia, Brazil and South Africa, customer mineral samples can be tested in-house with Huntsman’s technologies.

Our in-house capabilities allow Huntsman to quickly and efficiently review our chemistry combination with our client’s reagents. Our mineral processing lab in Melbourne, Australia was opened in 2013, this facility has mineral processing capabilities to provide reagent solutions for the beneficent mining industry and support customers regionally in South America.

To support Huntsman’s mining business in the Southern African region, we are seeing with Protex Mining Chemicals, a well-known local chemical distributor. With a well-equipped facility near Johannesburg, South Africa, Huntsman through Protex Mining Chemicals laboratory is able to respond rapidly to clients’ needs across the Southern African region.

These facilities are part of Huntsman’s commitment and focus to help innovators and develop new chemistries to improve efficiencies and meet tomorrow’s challenges for the mineral processing industry.

About Huntsman Performance Product

Huntsman’s Performance Products division is a leading global producer of intermediates, chemicals and technologies. Masters of molecular science, we create chemical building blocks — with unique features — that simplify the production and improve the functionality of differentiated formulations employed across diverse consumer markets and industrial applications.

From kind, gentle additives for skin and hair care formulations to powerful performance products that boost the performance of fuels and engine oils, our performance chemistries enable continual innovation in products that shape and improve the functionality of differentiated formulas across diverse consumer markets and industrial applications.

www.huntsman-miningchemicals.com
Technology Capabilities

To meet the increasing market demands within the mining industry, Huntsman recently invested in its mining laboratory facilities around the world. At these sites in Australia, Brazil and South Africa, customer mineral samples can be tested in-house with Huntsman’s resources.

Our on-site capabilities allow Huntsman to quickly and efficiently assess our chemistry combination with our client’s existing reagent suite, thus allowing us to optimize the overall chemistry applied. Our local sources also allow us to tailor closed-loop reagents by applying them to a client’s ore, obtaining a faster turnaround of results and enabling us to optimize the overall chemistry applied. Our local sources also allow us to tailor our chemistry combination with our client’s existing reagent suite, thus allowing us to optimize the overall chemistry applied. Our local sources also allow us to tailor our chemistry combination with our client’s existing reagent suite, thus allowing us to optimize the overall chemistry applied.

About Our Laboratories

Our mineral processing lab in Melbourne, Australia, opened in 2014 and is fully equipped with benchtop mineral sample preparation, flotation and basic analytical needs. Staffed with a number of metallurgists, technologists and technicians, this facility is well equipped to support clients’ needs, including product support and new product development to improve efficiencies in processing difficult-to-treat ores.

Huntsman has also made significant investments in a new lab in Sao Paulo, Brazil. Opened in 2013, the facility has mineral processing capabilities to provide reagent solutions for the Brazilian iron ore industry and support customers in the Brazilian iron ore industry and support customers regionally in South America.

To support Huntsman’s mineral processing business in the Southern African region, we are working with Protea Mining Chemicals, a well-established company operating in South Africa, to expand our mineral processing capabilities and support customers in South Africa.

About Huntsman Performance Products

Huntsman Performance Products division is a leading global producer of intermediate chemistries and technologies. Masters of molecular science, we create chemical building blocks — with unique features — that simplify the production and improve the functionality of differentiated formulations employed across diverse consumer markets and industrial applications. From kind, gentle additives for skin and hair care formulations to powerful actives that boost the performance of foods and engines, our performance chemistries enable continual innovation in products that shape and influence daily life.

About Huntsman Performance Products

With manufacturing sites and technical teams located around the world, Huntsman, through the Huntsman Performance Products division, is able to respond rapidly to clients’ needs across the Southern African region.

These facilities are part of Huntsman’s commitment to focus on innovation and new chemistry to meet mining efficiencies and meet tomorrow’s challenges for the mining and mineral processing industry.

www.huntsman-miningchemicals.com

OPTIMIZE" Mastering Molecular Science for Industrial Processing Solutions

Flotation Reagents for the Mining Industry
The POLYFROTH® series is a comprehensive range of specialty frothers offered by Huntsman Performance Products. The POLYFROTH® series aims to deliver the full spectrum of frothing properties and selectivity chemistries. As a group, they offer high selectivity and stability, and low level of toxicity and odor and are mostly non-flammable. Client feedback indicates that overall dose rates can be much lower than with alcohol- or glycol ether-based frother alternatives to MIBC and typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol blends.

The POLYFROTH® series is designed as a high flash point, mobile, dry froth with low to moderate stability. Performance is comparable to methyl isobutyl carbinol (MIBC) and low molecular weight, alcohol-based frothers.

The POLYFROTH® H27 is an intermediate strength, highly selective frother, comparable to MIBC and other low molecular weight, alcohol-based frothers. H27 was specifically designed as a high flash point alternative to MIBC and typically operates at a significantly lower dose than that of MIBC.

The POLYFROTH® H28 is a lower strength, highly selective frother, comparable to MIBC and other low molecular weight, alcohol-based frothers. H28 was specifically designed as a high flash point alternative to MIBC and typically operates at a significantly lower dose than that of MIBC.

The POLYFROTH® H57 is an intermediate strength frother that extends the properties of H27 but also offers a stronger hydrophobic glory ether component, enhancing the flotation froth kinetics and giving higher froth concentrate carry-over (mass pull).

The POLYFROTH® W31 is a highly synchronous, offering good froth persistence and stability, but less selectivity. W31 typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol blends.

The POLYFROTH® W55 was a polysiloxane frother that has established industry alternative to Dowfroth™ 250C. It produces relatively mobile and freely draining froths of intermediate strength. It offers a combination of selectivity, froth stability and moderate kinetics, and therefore can be used in a wide range of flotation applications, where a balance of selectivity and strength is required. W55 can also be viewed as an alternative frother to other intermediate-strength, intermediate-molecular weight, glycol ether/polyglycol blended frothers.

The POLYFROTH® W34 is an intermediate to high-strength frother with solution characteristics similar to W55. It produces froths with well-defined structure and bubble size and is available for applications requiring intermediate froth stability and good froth depth control.

The POLYFROTH® W55 and H57 are often used alone, where their strength allows them to float higher molecular weight impurities superior for coarse particle recovery in flotation circuits. They can be combined with other products to augment froth characteristics for desired properties and performances.

The POLYFROTH® series is a comprehensive range of specialty frothers offered by Huntsman Performance Products. The POLYFROTH® series aims to deliver the full spectrum of frothing properties and selectivity chemistries. As a group, they offer high selectivity and stability, and low level of toxicity and odor and are mostly non-flammable. Client feedback indicates that overall dose rates can be much lower than with alcohol- or glycol ether-based frother alternatives to MIBC and typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol blends.

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The POLYFROTH® H27 is an intermediate strength, highly selective frother, comparable to MIBC and other low molecular weight, alcohol-based frothers. H27 was specifically designed as a high flash point alternative to MIBC and typically operates at a significantly lower dose than that of MIBC.

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The POLYFROTH® W31 is a highly synchronous, offering good froth persistence and stability, but less selectivity. W31 typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol blends.

The POLYFROTH® W55 was a polysiloxane frother that has established industry alternative to Dowfroth™ 250C. It produces relatively mobile and freely draining froths of intermediate strength. It offers a combination of selectivity, froth stability and moderate kinetics, and therefore can be used in a wide range of flotation applications, where a balance of selectivity and strength is required. W55 can also be viewed as an alternative frother to other intermediate-strength, intermediate-molecular weight, glycol ether/polyglycol blended frothers.

The POLYFROTH® W34 is an intermediate to high-strength frother with solution characteristics similar to W55. It produces froths with well-defined structure and bubble size and is available for applications requiring intermediate froth stability and good froth depth control.

The POLYFROTH® W55 and H57 are often used alone, where their strength allows them to float higher molecular weight impurities superior for coarse particle recovery in flotation circuits. They can be combined with other products to augment froth characteristics for desired properties and performances.

The POLYFROTH® series is a comprehensive range of specialty frothers offered by Huntsman Performance Products. The POLYFROTH® series aims to deliver the full spectrum of frothing properties and selectivity chemistries. As a group, they offer high selectivity and stability, and low level of toxicity and odor and are mostly non-flammable. Client feedback indicates that overall dose rates can be much lower than with alcohol- or glycol ether-based frother alternatives to MIBC and typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol blends.

The POLYFROTH® series is designed as a high flash point, mobile, dry froth with low to moderate stability. Performance is comparable to methyl isobutyl carbinol (MIBC) and low molecular weight, alcohol-based frothers.

The POLYFROTH® H27 is an intermediate strength, highly selective frother, comparable to MIBC and other low molecular weight, alcohol-based frothers. H27 was specifically designed as a high flash point alternative to MIBC and typically operates at a significantly lower dose than that of MIBC.

The POLYFROTH® H28 is a lower strength, highly selective frother, comparable to MIBC and other low molecular weight, alcohol-based frothers. H28 was specifically designed as a high flash point alternative to MIBC and typically operates at a significantly lower dose than that of MIBC.

The POLYFROTH® H57 is an intermediate strength frother that extends the properties of H27 but also offers a stronger hydrophobic glory ether component, enhancing the flotation froth kinetics and giving higher froth concentrate carry-over (mass pull).

The POLYFROTH® W31 is a highly synchronous, offering good froth persistence and stability, but less selectivity. W31 typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol blends.

The POLYFROTH® W55 was a polysiloxane frother that has established industry alternative to Dowfroth™ 250C. It produces relatively mobile and freely draining froths of intermediate strength. It offers a combination of selectivity, froth stability and moderate kinetics, and therefore can be used in a wide range of flotation applications, where a balance of selectivity and strength is required. W55 can also be viewed as an alternative frother to other intermediate-strength, intermediate-molecular weight, glycol ether/polyglycol blended frothers.

The POLYFROTH® W34 is an intermediate to high-strength frother with solution characteristics similar to W55. It produces froths with well-defined structure and bubble size and is available for applications requiring intermediate froth stability and good froth depth control.

The POLYFROTH® W55 and H57 are often used alone, where their strength allows them to float higher molecular weight impurities superior for coarse particle recovery in flotation circuits. They can be combined with other products to augment froth characteristics for desired properties and performances.
The POLYFROTH® series is a comprehensive range of specialty frothers offered by Huntsman Performance Products. The POLYFROTH® series aims to deliver the full spectrum of frother properties (e.g., selectivity, water solubility and diffusion kinetics) and strengths required in mineral and coal mining applications. This is achieved by combining earlier chemistries. The greater froth persistence, together with higher water solubility of selected frothers in the POLYFROTH® series, can also offer a stronger hydrophobic diffusion component, boosting selectivity, froth stability and moderate-to-high strength. These can be used in a wide range of flotation applications, where a balance of selectivity, froth stability and moderate-to-high strength is required. W31 can also be viewed as an alternate frother to other mid-strength, intermediate-molecular-weight, glycol ether/propylene glycol-based frothers.

The POLYFROTH® H27 is a strong frother, offering high-to-moderate persistence and stability, but less selectivity. W31 typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol blends.

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The POLYFROTH® series is a comprehensive range of specialty frothers offered by Huntsman Performance Products. The POLYFROTH® series aims to deliver the full spectrum of frother properties (e.g., selectivity, water solubility and diffusion kinetics) and strengths required in mineral and coal mining applications. This is achieved by combining earlier TEC® and WINTEK® frothers with new technologies, as well as utilizing innovative new product development.

This special range of frothing properties and selectivity provides application and performance benefits in a wide range of flotation circuits. As a group, they offer high metallurgical grades with low water carry-over into the concentrate. The POLYFROTH® series is a comprehensive range of specialty frothers offered by Huntsman Performance Products.

### POLYFROTH® 10 Frother Series

**LOWEST STRENGTH**

- **POLYFROTH® H10** is among the weakest of the current POLYFROTH® range. H10 is selective in base and precious metal flotation, producing a mobile, dry froth with low to moderate stability. Performance is comparable to methyl isobutyl carbinol (MIBC) and low molecular weight, alcohol-based frothers.

**INTERMEDIATE STRENGTH**

- **POLYFROTH® W22** is a polyglycol ether frother that is an established industry alternative to Dowfroth™ 150C. It produces relatively mobile and freely draining froths of intermediate strength. It offers a combination of froth stability and moderate kinetics, and therefore can be used in a wide range of flotation applications, where a balance of selectivity and strength is required. W22 can also be viewed as an alternative frother to other intermediate-strength, intermediate-molecular weight, glycol ether/polyglycol ether-based frothers.

- **POLYFROTH® H27** is an intermediate-strength frother with solution characteristics similar to W22. It produces froths with weakly defined structure and bubble size and is available for applications requiring intermediate froth stability and good froth depth control.

### POLYFROTH® 20 Frother Series

**LOW TO MODERATE STRENGTH**

- **POLYFROTH® W24** is a lower strength, highly selective frother, comparable to MIBC and other low molecular weight, alcohol-based frothers. W24 was specifically designed as a high flash point alternative to MIBC and typically operates at a significantly lower dose than that of MIBC.

- **POLYFROTH® H28** is an intermediate-strength frother that extends the properties of W24 but also offers a stronger hydrophobic glycol ether component, covering the flotation froth kinetics and giving higher froth concentrate carry-over (mass pull).

### POLYFROTH® 30 Frother Series

**INTERMEDIATE STRENGTH**

- **POLYFROTH® W31** is produced relatively mobile and freely draining froths of intermediate-strength. It offers a balance of selectivity, froth stability and moderate kinetics, and therefore can be used in a wide range of flotation applications, where a balance of selectivity and strength is required. W31 can also be viewed as an alternative frother to other intermediate-strength, intermediate-molecular weight, glycol ether/polyglycol ether-based frothers.

### POLYFROTH® 50 Frother Series

**HIGHEST STRENGTH**

- **POLYFROTH® W55** is a strong frother, offering good froth persistence and stability, but less selectivity. W55 typically results in reduced dosage and better froth depth control than other alternative strong alcohol/polyglycol ether blends.

- **POLYFROTH® H57** is among the strongest, most hydrophobic in the series and produces dry froths. It is available for operations where strong froths are required to agitate the flotation coarse particles. It offers fast initial kinetics and can be used to help overcome frothing problems.

### Dynamic Surface Tension

<table>
<thead>
<tr>
<th>Frother</th>
<th>POLYFROTH® H19</th>
<th>W22</th>
<th>W24</th>
<th>H27</th>
<th>H28</th>
<th>W31</th>
<th>W55</th>
<th>H57</th>
</tr>
</thead>
<tbody>
<tr>
<td>mN/m</td>
<td>25</td>
<td>20</td>
<td>18</td>
<td>15</td>
<td>17</td>
<td>15</td>
<td>15</td>
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</tr>
</tbody>
</table>

### Viscosity (cP, 20°C)

<table>
<thead>
<tr>
<th>Frother</th>
<th>POLYFROTH® H19</th>
<th>W22</th>
<th>W24</th>
<th>H27</th>
<th>H28</th>
<th>W31</th>
<th>W55</th>
<th>H57</th>
</tr>
</thead>
<tbody>
<tr>
<td>cP</td>
<td>13</td>
<td>20</td>
<td>18</td>
<td>15</td>
<td>17</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
</tbody>
</table>

### Specific Gravity (25°C)

<table>
<thead>
<tr>
<th>Frother</th>
<th>POLYFROTH® H19</th>
<th>W22</th>
<th>W24</th>
<th>H27</th>
<th>H28</th>
<th>W31</th>
<th>W55</th>
<th>H57</th>
</tr>
</thead>
<tbody>
<tr>
<td>25° C</td>
<td>1.11</td>
<td>0.93</td>
<td>1.02</td>
<td>0.96</td>
<td>0.92</td>
<td>1.08</td>
<td>0.98</td>
<td>1.02</td>
</tr>
</tbody>
</table>

### Frother Applications - Ore Types

- **Flotation Frothers**
  - **Copper - chalcopyrite**
  - **Copper - bornite**
  - **Copper - azurite**
- **Gold bearing pyrite**
- **Nickel - pentlandite**
- **Lead - galena**
- **Zinc - sphalerite**
- **Platinum group elements**
- **Potash**
- **Coal**

### Frother Physical Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>POLYFROTH® H19</th>
<th>W22</th>
<th>W24</th>
<th>H27</th>
<th>H28</th>
<th>W31</th>
<th>W55</th>
<th>H57</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stability</td>
<td>Weak</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Froth Type</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
<td>Dry</td>
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<tr>
<td>Strength</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Stability</td>
<td>Low</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Intermediate</td>
<td>Intermediate</td>
<td>High</td>
<td>High</td>
<td>High</td>
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</table>

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Huntsman has also made a major investment in a new lab in Johannesburg, South Africa. Through this lab, high-tech mineral processing capabilities to provide reagent solutions for the Southern African mining industry and support customers regionally in South America.

To support Huntsman’s mining business in the Southern African region, we are scaling with Protea Mining Chemicals, a well-equipped facility near Johannesburg, South Africa. Huntsman through the Protea Mining Chemicals laboratory is able to respond rapidly to clients’ needs across the Southern African region.

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