Introduction

Longwall mining is an underground coal extraction method, which removes large volumes of coal with minimum impact to the surface environment.

It involves cutting parallel underground roadways to form “blocks”. A coal face is formed between these roadways and the coal is extracted by a mechanical “shearer”. The longwall advances as the shearer cuts back and forth from one roadway to another. The roof directly above and behind the shearer is supported by hydraulic jacks, creating a safe work area for the machinery and operators. These jacks require an operating pressure of around 4500 psi. The roof jacks contract, extend and edge forward individually, thus maintaining the roof directly in front of the coal face. At the same time, it allows the roof behind the advancing shearer, where the coal has been extracted, to collapse. Thus, there is no requirement for permanent support. This collapsed area is called the GOB and cannot be re-entered.

The underground atmosphere in the mine contains a dangerously explosive mixture of methane and coal dust. Additionally, the water table is sometimes only meters from the coal seam. It is mainly for these reasons that oil based hydraulic fluids are not used. A product referred to as a fire resistant hydraulic emulsion, also known as longwall fluid, is used instead. It is water based, containing special additives.

Application

Longwall hydraulic fluid loss from the hydraulic circuit is extremely high, requiring continuous replenishment. In older longwall systems as much as 113,562 liters (30,000 gallons) of neat emulsion can be used per month.

Efficient and reliable dosing of the longwall fluid is required in order to maximise the operating life of the
hydraulic components and pump systems. Excessively high levels of concentration can cause gasket failure resulting in leakage, while low level concentrations will reduce its corrosion prevention effectiveness, which may result in damage and system failure.

The K-Patents Process Refractometer is used for precise dosing and mixing of the fluid. The concentration of the longwall fluids ranges between 1 and 5% and has an approximate Brix gain of 0.6 (where 5% = around 3.5 Brix).

The K-Patents concentration measurement is unaffected by oil tank head pressure, water flow, pressure variations, raw oil concentrations or instrument location.

**Installation**

There are two typical installation types for the K-Patents Process Refractometer:

**Underground:**

The roof supports require hydraulic pumps driven by large electric motors to supply 4500 psi in order to function properly. These pumps are mounted on a pump cart and supplied from a mixed emulsion tank. The emulsion is then recycled from the coal face to the tank. The tank is replenished with fresh emulsion in batch mode when the tank levels drop.

The best installation point is in a dedicated recirculation loop drawing from and returning to the mixed emulsion tank.

**Surface:**

Some mines prepare emulsion above ground and then transfer the mixed emulsion underground through a pipe.

In this installation, as there is no return line, only the fresh emulsion is measured. Provided there is no interference, the fresh emulsion and underground return emulsion should remain at the same concentration.

**Instrumentation**

Application considerations:

- Prism coating occurs even at the low concentrations, in cases when the flow velocity is less than 1.8 m/sec continuous. Sometimes, if the water hardness varies, soap will form and cause prism coating irrespective of velocity. For these reasons automatic prism wash with steam may be needed.

- Explosion protection is typically required. Appropriate equipment with hazardous and intrinsic safety approvals are available when required.

In some cases it may even be desirable to mount the whole refractometer system in an EXd-enclosure. In such cases, the PR-23 remote panel and usability via Ethernet connection still allows for easy operation without having to access the transmitter.

<table>
<thead>
<tr>
<th>Instrumentation</th>
<th>Description</th>
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| K-Patents Process Refractometer PR-23-GP | is an industrial refractometer for large pipe sizes and tanks, cookers, crystallizers and kettles. Installation through a flange or clamp connection.

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<thead>
<tr>
<th>Automatic prism wash:</th>
<th>Prism wash with steam.</th>
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<tr>
<td>Area classification:</td>
<td>Intrinsic safety and hazardous area approvals available.</td>
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<tr>
<td>Measurement range:</td>
<td>Refractive Index (nD) 1.3200 – 1.5300, corresponding to 0-100 Brix.</td>
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