Innovation and Expertise in Instrumentation
Inline measurement of the concentration of cutting oils and cooling lubricants with process refractometer IPR

• Schmidt & Haensch GmbH

• Basics...
  a) ... of the iPR Series
  b) ... of the significance of lubricants in process
  c) ... of place of use for lubricant measurement

• Scientific consideration
  a) RI and Temperature
  b) Scales (Brix) and specific lube factor
  c) Real example

• Profitability analysis
Sales and Service Partners all over the world in more than 80 countries:
II) Basics...  
... of the iPR-Series:

- **Principle of Process Refractometer: Total reflection**

![Diagram of light path through a YAG prism and optical glass fibre with a photo diode array detecting totally reflected light.]

**Advantages:**

Detection of **reflected** light (instead of continuous light):

Results completely **independent** of:

- **Colour**
- **Turbidity**
- **Density**
Basics of the significance of lubricants in process

**for what reason:**
According to **TRGS* 611**, the legislator prescribes regular inspections.

**Too low concentrations:**
- Enables bacterial growth
- reduces cutting capacity and leads to longer processing times
- poor surface finish
- ineffective lubrication and deposits when welding tools

**Too high concentrations:**
- means excessive use of lubricant (expensive) and grease contamination (difficult to remove)

*Technische Regeln für Gefahrstoffe (TRGS)*
Technical Rules for Hazardous Substances
Basics of place of use for lubricant measurement

1. Cooling/cutting
During machining, the metal must be cooled and lubricated.
- via a central system,
- local systems on site

2. Monitoring the quenching liquid:
- the right concentration impacts the quality!

3. Washing
- Clean parts from oil and dirt
- Protection from corrosion during storage
- to ensure that excess fats and oils have been completely removed

4. Rinsing
- for welding,
- be refilled when the concentration value reaches its saturation limit
III) Scientific consideration:

a) RI and Temperature:
III) Scientific consideration:
b) Scales (Brix) and specific lube factor

<table>
<thead>
<tr>
<th>product</th>
<th>concentration</th>
<th>Brix</th>
<th>Temp. [°C]</th>
<th>specific factor</th>
<th>result [wt%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>weighed in</td>
<td>(measured)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xxx</td>
<td>2,50</td>
<td>1,42</td>
<td>ca. 23</td>
<td>1,8</td>
<td>2,56</td>
</tr>
<tr>
<td>xxx</td>
<td>5,00</td>
<td>2,82</td>
<td>ca. 23</td>
<td>1,8</td>
<td>5,08</td>
</tr>
<tr>
<td>xxx</td>
<td>10,00</td>
<td>5,45</td>
<td>ca. 23</td>
<td>1,8</td>
<td>9,81</td>
</tr>
</tbody>
</table>
The curve shown here is a **concentration curve over several weeks (measured hourly)** (Central plant **60 m³**) 6% is the minimum value and 7% the maximum value for the investment.

This central system was **operated "badly"** in the period shown here. For the representation of the performance of the refractometer, however, optimally suitable.
III) Scientific consideration:
c) Real example

A continuously operated plant, measured at an hourly rhythm*:

- Bacteria
- pH-value
- concentration

*Measured by rhenus FluidSafe
III) Scientific consideration:
c) Real example

- so-called limit value mode of operation by permanent concentration measurement
- permanently drive the concentration at the still permitted minimum and allow only the smallest tolerances
- saves the user cooling lubricant quantities
- By the automatic permanent concentration measurement no longer sink below the minimum
III) Scientific consideration:
c) Real example
III) Scientific consideration:
c) Real example

Light distribution and gradient for one measurement:
IV) Profitability analysis:

calculated on a **small central plant of 20 m³**
with **10%** lubricant content: (when turning the bath)

<table>
<thead>
<tr>
<th>Price of lubricants 1m³:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Product A:</td>
<td>5532 €</td>
</tr>
<tr>
<td>Product B:</td>
<td>5188 €</td>
</tr>
<tr>
<td>Product C:</td>
<td>5700 €</td>
</tr>
</tbody>
</table>

-----------------------------------------------

| In plant 2m³ approx.: | 10 000 € |

hazardous material:
external disposal 80-100 €/m³ in GER
approx.: 1800 €

**Return of invest:**
- with a typical bath life extension of 10 months

0.5< ROI <1 year

**is not taken into account:**
- cleaning material
- Working hours for cleaning (up to several days)
- possibly broken CNC machine (approx. 120 000 €/machine)
- Production downtime for several days (several thousand to millions/day)