on-line SALT in Crude Oil
by UPA® Universal Process Analyzer

Salt left in the Crude-oil after Desalting frequently results in higher corrosion rates in the further refining processes and can damage the catalysts used.

by

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Technical Description: **on-line** analyzer system for the determination of SALT in Crude Oil

**PART I**  
**on-line** SALT in Crude Oil  
by UPA® Universal Process Analyzer

Salts are naturally present in crude oil when it is produced from oil wells. When crude oil is distilled in the refinery, it is heated to over 800°F, causing the salts to become very corrosive. On top of that many of the refinery processes make use of expensive catalysts in order to speed up the reactions. Besides corrosion of the installations, the salts present in the crude can also damage the catalysts.

For this reason each refinery has a DESALTER unit to remove the inorganic chlorides and other water soluble compounds form crude oil. The desalting is usually the first process in crude oil refining of a refinery.

To remove the salts, wash water is added (mixed under turbulence) to the crude in the incoming crude feed line. The crude oil and the water are run through a mix valve which brings the salts in contact with the water droplets. The emulsion of crude oil & water created by the mix valve must be quickly separated inside the DESALTER. Brine is discharged from the bottom, and crude oil is discharged from the top of the DESALTER. The crude oil discharged must contain < 0.5% water, otherwise when heated, it can over-pressurize the distillation column.

To ensure oil dehydration inside the DESALTER, electrostatic grids are added to optimize coalescence. However, if too much water reach the grids, it will cause them to electrically overload and shut down.

**Figure 1:** DESALTER principle
To prevent this, emulsion breaking chemicals are added to the incoming crude to assist in oil/water separation.

The continuous change of oil/water concentrations makes it very difficult to optimize the process. If salts reach a distillation column corrosion damage is extensive.

The salt content after the DESALTER is usually measured in PTB - pounds of salt per thousand barrels of Crude Oil. The operation of a desalting unit is very difficult due to commonly changing process conditions such as crude feed quality, crude water content, interface level control of emulsions, mixing, grid loading etc...

Desalting is a continuous and difficult process, especially since phase separation of emulsions (non dissolved mixture of water and oil) is not that easy. Controlling the interface level of Oil – Emulsion (non dissolved mixture of water and oil) – Water inside the DESALTER is typically done by interface level measurements that are not always that correct.

To improve the quality of the crude after desalting a on-line accurate and quick measurement is needed by UPA® on-line Universal Process Analyzer for the determination of SALT in Crude Oil.
## PART II

**on-line SALT in Crude Oil**

**DESCRIPTION**

by **UPA® Universal Process Analyzer**

The on-line Universal Process Analyzer - **UPA® on-line Universal Process Analyzer** is a versatile wet chemical analyzer suitable for chemical analysis and monitoring of industrial process solutions.

### 1. FEATURES **UPA® Universal Process Analyzer system for on-line SALT in Crude:**

- The **UPA® on-line salt in crude analyzer system** is purged with instrument air.
- The **UPA® on-line salt in crude analyzer system** wet-part has automatic cleaning.
  - The user can program the sequence and interval of the analysis and Cleaning cycles.
- The **UPA® on-line salt in crude analyzer system** has an automatic validation/calibration.
  - The user can program the sequence and interval of the analysis and validation/calibration cycles. A validation/calibration can be performed with a validation/calibration solution with known concentration in order to check the analysis program and the analyzer.
- The **UPA® on-line salt in crude analyzer system** has an unique Human interface.
  - The touch screen PC + keyboard with flash disc that is incorporated in the instrument and controls the analyzer and memorizes trends, alarms, results and data log files.
- The **UPA® on-line salt in crude analyzer system** needs NO External PC. The results can be recorded on a memory stick and used in a spreadsheet program such as Excel or any other data processing software.
  - Result & Alarm data export (1,000 results including sample stream, date & time)
  - **UPA® program up- & download**
The control of the UPA® on-line salt in crude analyzer system screen can remotely be taken over by another PC over a Local Area Network (LAN) using commonly available VNC™ Ethernet software.

**2. METHOD**  
**UPA® Universal Process Analyzer system for on-line SALT in Crude**

**REMARK:** The applied analysis method is conform with the ASTM D3230 method.

**Batch type analysis:**
- Draining of analysis vessel
- Rinsing of analysis vessel with Naphtha
- Draining of analysis vessel
- Sampling of a fixed volume of filtered crude sample
- Adding a precise volume of xylene
- Adding a precise volume of Alcohol
- Mixing and heating to 45-50°C
- Measurement of Conductivity
- Calculating of Salt result

**REMARK:** The batch-wise operating principle guarantee you following advantages:
- allows you to program the analysis sequence according to your needs.
- limited loading of the electrodes.
- rinsing and cleaning after each analysis cycle
3. SPECIFICATIONS  
**UPA® Universal Process Analyzer system for on-line SALT in Crude:**

Ex Proof conform ATEX protection zone II3G

(REMARK: Ex Proof version conform NEC500 is possible on request)

Methodology:
- Batch Conductivity - chloride (salts) in crude - conform ASTM D3230

Possible ranges:
- 0 - 15 / 0 - 400 PTB
- 0 – 1000 mg/liter Salt Content (selectable)

Cycle time:
- 6 – 10 minutes

Repeatability:
- ± 2% FS

Reproducability:
- ± 1% FS

Accuracy:
- ± 5% of measurement, correlates with ASTM D3230

Calibration/Validation:
- Calibration/Validation program (sequence is time based & independent from other programs)

Sample Requirements:
- Sample Pressure max. 14 kg/cm² (bar) or 200 psi
- Sample Temperature: 15° - 60° C or 60° - 140° F
- Sample Return Pressure: 0.4 kg/cm² (bar) or 6 psi < Sample Pressure

Drain:
- Atmospheric

Chemicals:
- Xylene per ASTM D843
- Alcohol mixture 37/63 mix of absolute methanol and n-Butanol (reagent grade)

Cleaning:
- Naphta per ASTM D91

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### General Software Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB port</td>
<td>result &amp; alarm data export (1,000 results including sample stream, date &amp; time)</td>
</tr>
<tr>
<td></td>
<td>data curve export (last 30 analysis curves)</td>
</tr>
<tr>
<td></td>
<td>UPA® program upload</td>
</tr>
<tr>
<td>Emergency STOP</td>
<td>Hardware “reset push button” or on touch screen</td>
</tr>
<tr>
<td>REMOTE touch screen take-over</td>
<td>The control of the UPA® analyzer touch-screen can remotely be taken over by another PC over a Local Area Network (LAN) using commonly available VNC® Ethernet software.</td>
</tr>
<tr>
<td>Built-in PC</td>
<td>Flat color touch screen / diameter 210 x 160 mm (10,4&quot;) / IP65 Compact flash disk (128 MB) incorporated</td>
</tr>
<tr>
<td>flexible stirrer speed</td>
<td>Speed adjustable on touch screen</td>
</tr>
<tr>
<td>If/then programming</td>
<td>start an action based on a threshold condition</td>
</tr>
</tbody>
</table>

### 'MAIN' screen

<table>
<thead>
<tr>
<th>Sub-screen</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'VALUES'</td>
<td>actual values of sensors and or calculated results</td>
</tr>
<tr>
<td>'RESULT GRAPH'</td>
<td>trending last 80 analysis results in graph on screen</td>
</tr>
<tr>
<td>'DATA GRAPH'</td>
<td>UPA® colorimetric on-line analyzer single graph</td>
</tr>
<tr>
<td>'SERVICE'</td>
<td>table: “active program” / “analysis cycles” / “stream cycles” / “runs” / “counts”</td>
</tr>
<tr>
<td>'ACCESS'</td>
<td>Calibration / Validation (automatic or manually)</td>
</tr>
</tbody>
</table>

### 'STATUS' screen

<table>
<thead>
<tr>
<th>Sub-screen</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'ANALYSIS'</td>
<td>manually ON / OFF control of wet part components</td>
</tr>
<tr>
<td>'SAMPLING'</td>
<td>stream selection (up to 8 different sample streams)</td>
</tr>
<tr>
<td>'DISPENSERS'</td>
<td>manually action control: “FILL” / “DOSE” / “RECYCLE” / “INIT” / “PRIME” (max. 4 dispensers)</td>
</tr>
<tr>
<td>'OUTPUT'</td>
<td>manually output simulation control</td>
</tr>
<tr>
<td>'SENSORS'</td>
<td>actual value and manually calibration (up to 4 different sensors)</td>
</tr>
</tbody>
</table>

### 'DATA' screen

<table>
<thead>
<tr>
<th>Sub-screen</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>'ANALYSIS'</td>
<td>logging list of last 1,000 results including sample stream / date / time</td>
</tr>
<tr>
<td>'ALARMS'</td>
<td>logging list of pending Alarms and history including Alarms / date / time</td>
</tr>
</tbody>
</table>
### Technical Description:

**on-line analyzer system for the determination of SALT in Crude Oil**

<table>
<thead>
<tr>
<th>PROGRAM screen password protected!</th>
<th>SETUP screen password protected!</th>
</tr>
</thead>
<tbody>
<tr>
<td>- max. 8 different programs</td>
<td></td>
</tr>
<tr>
<td>- initialization program (brings the UPA® analyzer in a safe status after power cut or start)</td>
<td></td>
</tr>
<tr>
<td>- calibration/validation program (sequence is time based independent from other programs)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HARDWARE sub-screen</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- configuration of max. 40 digital outputs</td>
<td></td>
</tr>
<tr>
<td>- configuration of max. 12 digital inputs</td>
<td></td>
</tr>
<tr>
<td>- configuration of 4 dispensers max.</td>
<td></td>
</tr>
<tr>
<td>- configuration of results</td>
<td></td>
</tr>
<tr>
<td>- configuration of preconditioning</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMUNICATION sub-screen</th>
<th>OPTIONS sub-screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>- configuration serial ETHERNET and MODBUS</td>
<td>- touch screen calibration</td>
</tr>
<tr>
<td>- configuration time / date</td>
<td></td>
</tr>
</tbody>
</table>

**4. PRECONDITIONING UPA® Universal Process Analyzer system for on-line SALT in Crude:**

**Remark:** Ex Proof version conform ATEX protection zone II3G

Crude sample: integrated preconditioning system

\[
P_{\text{design}} = 5.6 - 14 \text{ kg/cm}^2 \ (\text{bar}) \ / \ 80 - 200 \text{ psig} \\
T_{\text{design}} = 15 - 60^\circ \text{C} \ / \ 60 - 140^\circ \text{C}
\]

On top of that the system is equipped with a double stainless steel type particle filtration with manually controlled switch over system.
Technical Description: on-line analyzer system for the determination of SALT in Crude Oil

**PART III**

**PROJECT TEAM**

**Partners in on-line analyzer systems for Safety & Control of production plants**

AppliTek delivers complete on-line analyzers systems and can offer consultancy on existing, or possible new on-line analyzer systems, preventive maintenance programs & training on a Worldwide basis. All our analyzer systems are FIELD PROVEN and considered as Best Available Technology. For such delicate processes it is recommended to work with companies that have a good experience in this application field. AppliTek can offer you a SINGLE SOURCE RESPONSIBILITY

**in-house Engineering turn-key projects**

- In-house CAD Expert team
- In-house Ex Proof (ATEX) Expert team
- In-house Software/PLC expert team
- In-house Preconditioning expert team
- Cost planning
- Basic & Detail engineering
Technical Description:

on-line analyzer system for the determination of SALT in Crude Oil

High Qualified International Service - Application, Support & Training team

- In-house quality & safety control
- Flexibility in changes of scope of supply
- Project & Site Management
- Factory Acceptance Test (FAT) by customer prior to shipment, guaranteeing full compliance.
- NEW turn-key package workshop
- Site Acceptance Test (SAT)
- Start up & Test run
- Operator’s product training
- Maintenance contracts

in-house Wet-Chemical & Spectroscopic Application Support Laboratory

- Advice of best analysis method for customer analysis needs, since 1985.
- In-house feasibility studies & application development.
- Danger Assessment Studies
- In-house customer & product training

We DO NOT provide you with an analyzer!
We provide you a solution for a measuring problem

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