



## Multi Stream TOC-analysers for Return Condensate and Boiler Feed Water applications

ODS offers on-line multi-stream TOC-analysers to monitor the purity of return condensate, boiler feed water and steam condensate. ODS also offers tailor made sample conditioning systems. We supply complete walk-in shelter with utilities, sample conditioning and the multi-stream analyser system. ODS has experience in building and certifying these systems for use in the explosion hazardous ATEX zone 1 or 2. Nowadays the TOC or TC-levels to be monitored are often as low as 0,2 ppm (0,2 mg/litre C.). It is clear that the analytical performance of the Multi Stream TOC-analyser system should be outstanding. ODS TOC-systems are stable, are fast, have no carry over effects, are easy to calibrate/validate, need low maintenance and can be either stand alone or remotely controlled by a DCS/ computer system.

### Repeatability and reproducibility

The Quick-TOC-condensate analyser is manufactured by LAR Process Analysers AG in Berlin. This unique high performance TOC-analyser uses a multi-loop injection system in combination with thermal oxidation at 1200 °C. and a NDIR CO<sub>2</sub>-gas analyser. This so called batch principle has the advantage that an auto zero correction can be performed prior to every injection. Then the processor calculates the measured CO<sub>2</sub> peak surface. This technique has resulted in achieving an excellent performance. The lowest detectable limit is <10 ppb, the repeatability is < 2% of percentage of reading and the reproducibility is < 1%. When monitoring TOC-levels as low as 0,2 ppm, this outstanding performance is of vital importance.

### Response time and cycle time

Due to the use of non-catalytical thermal combustion technique at 1200 °C the Quick-TOC-condensate is the fastest TOC-analyser on the market. The recovery is 100%, all hydrocarbons are completely combusted. The analyser cycle time is 3 minutes (TC) or 5,5 minutes (TOC). For example: The complete cycle for a 4-stream TC analyser is 12 minutes (4 times 3 minutes).

### Carry over and memory effects

A stream with a high TOC-level should not be carried over to a next stream with a low TOC-level (and visa versa). All wetted parts, such as the internal stream selector with solenoids and manifold, are made of Teflon or PEEK. The internal volume and dead volumes are negligibly low. All wetted parts are flushed. This all results in very low adsorption and adsorption effects and low memory effects. Carry over effects are very low.



Panel with sample conditioning & multi stream TC-analyser



The Quick-TOC-condensate LAR with multi-loop injection



Stream selector with PEEK manifold



A chemical industry where ODS installed a 5-stream TC-analyser



Buffer tanks with boiler feed water



Co-generator. ODS installed three return condensate TC-analysers



Transport pipes with Return Condensate



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### Signal outputs: Sample & Hold technique

Each stream's TOC-value is available via a separate 4-20 mA signal output. Each TOC-signal is hold as long as needed and updated after every next analyses. This technique is called Sample & Hold. The 4-20 mA signal outputs are isolated and therefore can be directly hooked up to a remote DCS-system.

### Remote control

The multi stream TOC analyser can run as a stand alone system or can be remotely controlled via a DCS system. Normally the TOC-analyser system is used as a stand alone system. It automatically samples stream 1 .. N, 1...N, etc. Via the remote control inputs streams can be skipped. For example: when return condensate stream 2 is not available (factory shut down) than this input can be selected and skipped/disabled. The analyser system will now cycle from 1,3..n, 1, 3 ... n, etc.

Another example: If the TOC-value of one stream is too high due to contamination, then the other streams can be skipped/disabled resulting in a more frequent sampling of the contaminated stream. When the cause of the contamination is found (for example a leaking heat exchanger), then one by one the other streams can be enabled.

The remote control inputs are of the "opto coupler" type. They safely can be hooked up to a remote DCS system.

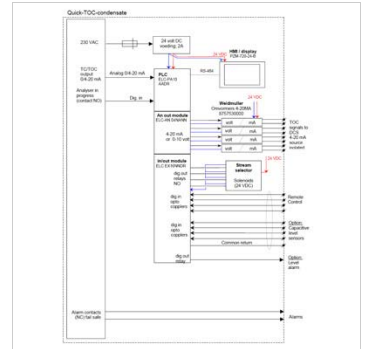
### Sample flow alarms

The TOC-analyser system uses sensors to monitor the supply of the samples. We use ODS-design external mounted sample overflow cups. The volume in each overflow cup is about 200 ml. The sample supply flow should be about 0,5 l/m. The water level in the overflow cup is monitored via a capacitive level sensor. The analyser sucks the fresh sample out of the overflow cup. When there is no or too little sample flow, the level will fall which will be detected. These sensor outputs are connected to the controller. A general flow alarm output is activated. If a specific sample stream is disabled (via remote control), then the level alarm of this specific stream is ignored.

Note: We experienced that this method is more stable then using standard rota flow meters with sensors. In cases where the process pressure of the return condensate is fluctuating, the sample supply is also fluctuating generating false flow alarms.

### Diagnostics

The analyser is easy to operate. It uses extra internal diagnostic sensors and a software package to control all vital functions. Temperature sensors monitor the correct function of the oven and sample cooler. A humidity sensor monitors the correct function of the sample cooler and checks if sample was injected. Mass flow sensors measure the carrier gas flow at inlet and outlet.



Block Diagram of the stream selector controller.



Overflow vessels with level alarm sensors detect sample supply



Service engineers inspect the Quick-TOC-condensate analyser



Via a high Pressure Pump for boiler feed water



E-generator operates via HP steam.



Power plant generates E-power and steam for chemical plants



Site with 3 Co-generators





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### Calibration and Validation:

The Quick-TOC-condensate analyser can either be calibrated or validated via a wet chemical standard or via a certified calibration gas.

At TOC-levels as low as 1 ppm it is extremely difficult to prepare and store a stable reliable wet chemical standard. The problem starts with getting real "blanc water". This water should contain a TOC or TC-level lower than 1% of the analyser range. In practice it is not possible to get any lower than ~5 ppb (0,005 ppm). Further the used chemicals (KHP) should be very pure. They need to be dried, weighted on a balance and being mixed with the blanc water to the correct calibration concentration. Obviously the used handling materials such as glass bottles should be perfectly clean. Contamination of the sample due to organics, particles or CO<sub>2</sub> (from ambient air) should be prevented. So to be able to make a wet chemical standard a well equipped laboratory is needed and the job needs to be scheduled and performed by well educated skilled personal.

A easy to perform method is the patented gas validation method. The injection loop of the Quick-TOC-condensate analyser is filled with a certified calibration gas and then injected into the reactor. Just the same way as the wet standard would be injected. The certified gas is stable and available at all time. At any moment anyone can rapidly validate the TOC-analyser. In case of validation the calibration parameters are kept and unchanged.

### Grab samples:

If the TOC-analyser alarms due to contaminated return condensate then normally the plant operation will activate a drain valve. Expensive condensate water is then spilled to drain. In a power plant many heat exchangers are used. Obviously it is important to find, as fast as possible, which heat exchanger is leaking. The Quick-TOC-condensate has the advantage that separate grab samples can be analysed separately.

### Human Man Interface (HMI)

Via a full colour display with touch screen the operator can monitor:

- The progress of the measurement cycle. E.g. which selection valve is activated.
- The actual TOC-values per stream.
- The history of TOC-values per stream: table or graph (FIFO).
- The sample flow (level) alarm status.

### Utilities:

Only electrical power and instrumentation air is used. By use of a zero air generator the instrumentation air is scrubbing out hydrocarbons and CO<sub>2</sub>.

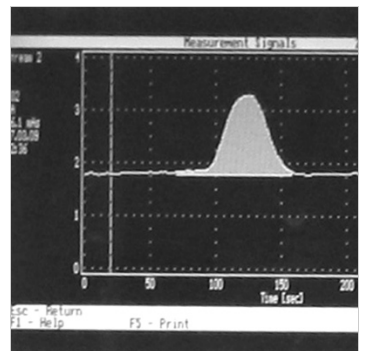
ODS offers the most dedicated complete multi stream analyser systems on the market. We have used over 25 years of experience to complete and improve our multi stream TOC-analyser systems.



Validation or calibration via a wet chemical standard (benchmark)



Validation via a stable certified gas mixture (CO<sub>2</sub> or CH<sub>4</sub> in N<sub>2</sub>)



peak surface calculation of a gas peak



Walk in shelter at a chemical site



TOC-analyser with sample conditioning panel



Zero Air supply with catalytical oxidation and PSA



3-stream sample conditioning