

DSR in Mixed Acids Production

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What is DSR

- Density & Sound Velocity Transducer
- Equipment for continuous component determination of the mixed acid (MA)
- Used directly in a production
- Real time analysis based on physical properties



DSR applications

- Concentration determination in ternary solutions (three-component systems)
 - alcohol-extract-original extract of beer (brewery)
 - partially inverted sugar solutions (sugar industry)

- effort to use DSR in MA production in Synthesia



Why DSR

- Consideration of the new technology concept
 - preparation, mixing and regeneration of waste mixed acid (WMA)
- From batch to continuous production



Current production status

- Batch production
 - time consuming process
 - time consuming analyzes
- Storage capacity
 - large number of storage tanks
 - large volume of MA
- Energy and raw materials
 - high consumption of acids
 - high demands on MA tempering
 - cooling
 - heating
- Hazard and Safety
 - operating accidents
 - MA leakage
 - high demands on operating safety



New technology concept

- From batch to continuous production
 - MA production simplifying
 - fast production
 - fast analyzes
- Reduction of storage capacity
 - storage tanks reduction
 - MA volume reduction
- Energy and raw materials
 - lower consumption of acids
 - savings during MA tempering
 - cooling
 - heating
- Hazard and Safety
 - Hazard reduction



New technology concept

- Continuous regeneration requires
 - very fast response to the current system composition
 - controlling software must be able to react quickly
 - precise dosing of the individual components
 - very fast and accurate analysis
 - the results as soon as possible
 - no affection
 - error elimination



MA production

Current status

1. Sampling
2. Laboratory analysis
3. WMA repair
4. Acid pumping into the tank
5. Acid mixing
6. Sampling
7. Laboratory analysis
8. Result

New concept

1. Entering the required concentration
2. DSR real time analysis
3. MA components dosage
4. Continuous regeneration under DSR control
5. Final MA



Measuring principle

- Density measurement
 - frequency determination of a U-shaped tube through which the liquid is passed
- Sound velocity measurement
 - sound speed with which sound propagates in the liquid
- Temperature
 - also measured

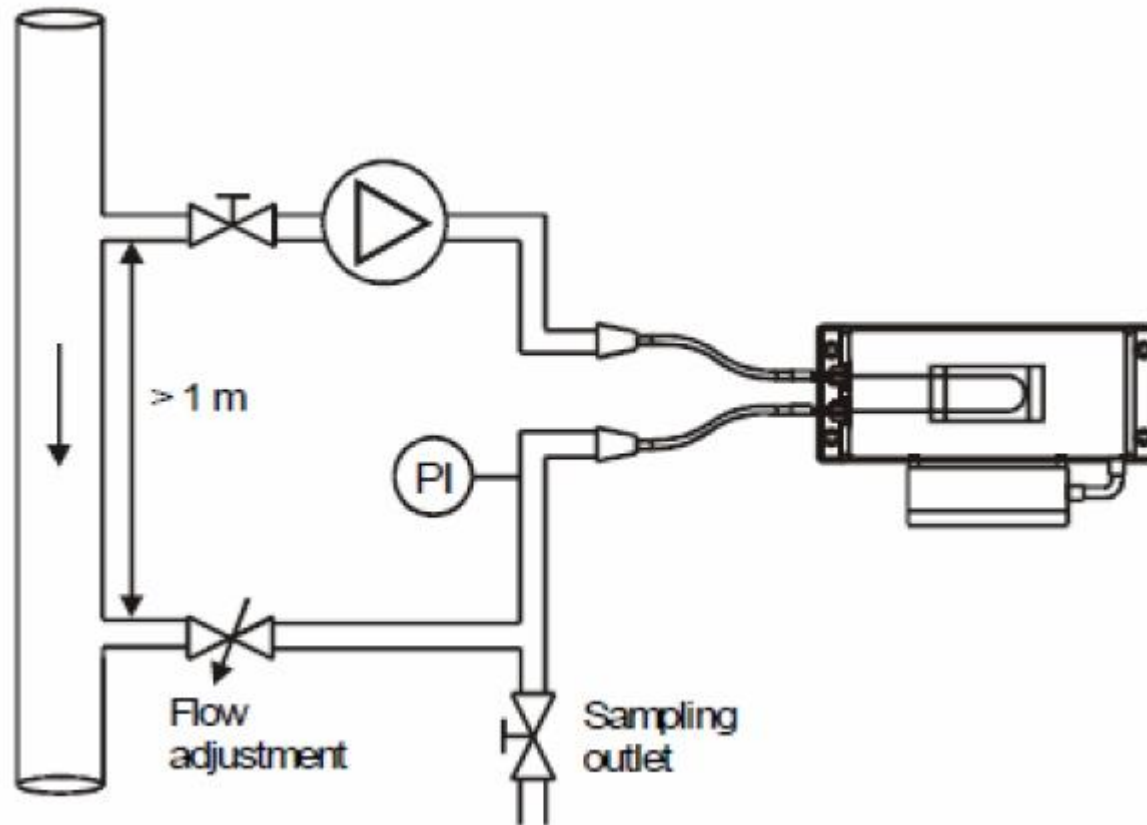


Evaluation

- Results are transmitted to the evaluation unit
 - determination of three component system concentration
- Assumption
 - For each combination of density and sound velocity in MA at a given temperature exists only one concentration of each MA component
 - this principle is used in the food industry
 - it is expected to obtain very accurate results



DSR-pipeline connection

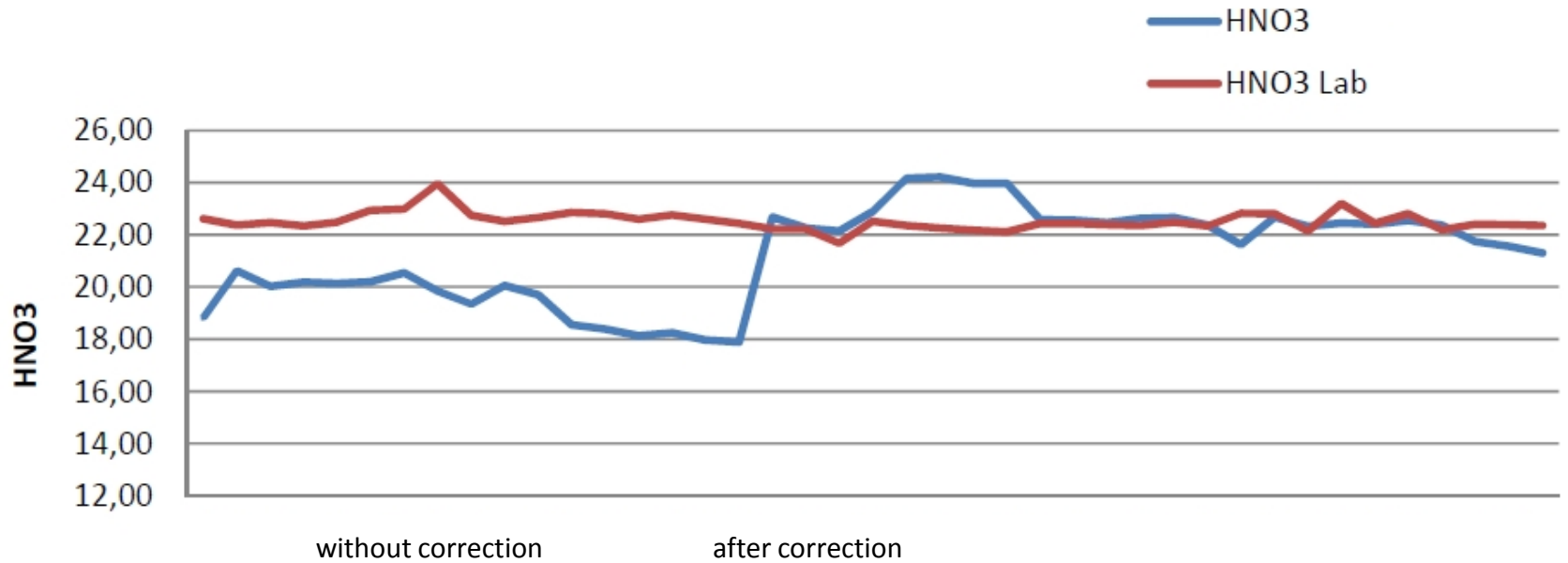


Calibration process

- Identification of the working area
 - MA concentration range
- Identification and measuring of the source area slightly wider than the working area
 - only interpolation method can be used
- Definition of a mathematical relationship
 - of the source area
- Verification of the mathematical relationship with the laboratory results
 - required error result max. $\pm 0,3\%$
- Long-term verification of mathematical relationship
 - required error result max. $\pm 0,3\%$



Mathematical relationship



Long-term verification of mathematical relationship

- Currently in the process
- Sampling 4x/day
- Laboratory results are assigned to DSR results
- Verification/Recalibration of mathematical model
 - Synthesia requirement
 - error result max. $\pm 0,3\%$
 - 1. stage
 - error result achievement $\pm 1,5\%$
 - 2. stage (nowadays)
 - error result achievement $\pm 1\%$



DSR properties

Advantages

- Analysis in the pipeline
 - no sampling
 - no acid handling
- Immediate evaluation
 - results in real time
 - online transmission
- Hostile environment housing
- Maintenance-free
- Long operating lifetime
 - correct usage

Disadvantages

- Indirect method
- Precise calibration necessary
 - time-consuming





Thanks for your attention

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