News

No. 12

PLEVA

SENSORS AND CONTROLS

## Oxygen Content and Steam Saturation in a Textile Steamer (PLEVA OS 90)

The presence of small amount of oxygen in textile steamers for printed or dyed fabric can be the cause for e.g.

- loss of fixation yield
- reproducibility problems
- oxidation spots

To avoid these problems , significantly more steam is normally admitted to the steamer than is really necessary for the heating-up process. The function of steam according to the different dyestuff classes will be as follows.

| | |
|---|---|
| Reactive dyeing and printing | —> energy transfer only |
| VAT dyeing | —> energy transfer / oxygen free |
| Discharge printing (VAT) | —> energy transfer / oxygen free |

**The perfect situation in a textile steamer is to create "saturated steam" of around 99,95 Vol% $H_2O$ which cannot carry more liquor or humidity.**

**Definitions:**

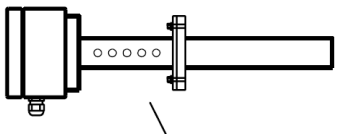
| | |
|---|---|
| Steam | —> water in a gaseous stage |
| Saturated steam | —> cannot carry more liquor or humidity |
| Overheated steam | —> is the result of saturated steam which will be continuously heated up at a constant pressure. (standard steam pipe net work of 140– 170 °C at a pressure of 3,5—7 bar) |
| Unsaturated steam | —> is generated by overheating saturated steam, or by enlarging the volume of the saturated steam with constant temperature |

**Composition of Natural Dry Air**

**21 Vol% Oxygen**
**78 Vol% Nitrogen**
**1 Vol% other gases**

**Limits:**
Prescriptive limits of oxygen content in a steamer for **discharge printing or dyeing with VAT dyes** from practice are

- **< 0,045 Vol% oxygen or**
- **> 99,78 Vol% $H_2O$ steam saturation**



**PLEVA OS 90 sensor**

On classical loop steamers for printing it is essential to mount the oxygen sensor very close to the inlet approximately 1 - 1,5 m from the fabric infeed. The position of the sensor is an essential point to improve process safety.

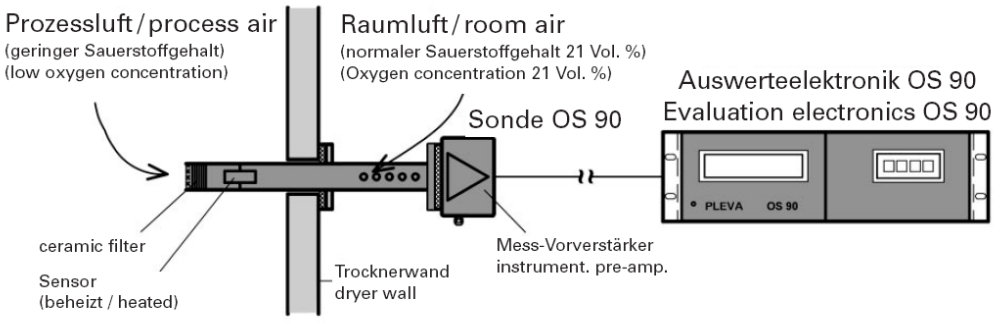



*Fig. 2: Blockschaltbild*
*Block diagram*
*Diagram de comutación*

### Measuring principle

The heated $ZrO_2$-sensor (> 700°C) has two electrodes. One of these electrodes is exposed to the process air, and the other is exposed to the room air. The sensor issues a specific voltage signal as a function of the oxygen content of the process air. This signal is conditioned in the measuring preamplifier for further processing by the evaluation electronics.

The evaluation electronics computes the oxygen content on the basis of the measuring preamplifier's signals with the aid of a microcomputer. In the case of pure mixtures of water steam and air additionally the saturation of the steam is measured. The unit of measurement is Vol. %.

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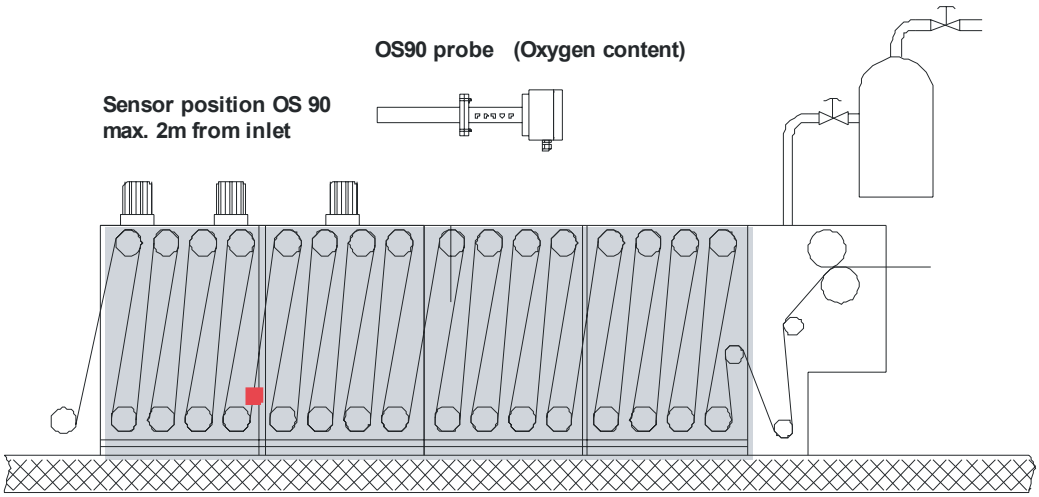
## Oxygen Content and Steam Saturation in a Textile Steamer (PLEVA OS 90)

The ideal measuring position in a steamer depends on the individual construction and the position of steam injection and exhaust pipe .

The fact that oxygen is heavier than air and therefore will drop down in the steamer will lead to a ideal sensor position slightly above the bottom redirection of fabric as shown in the drawing.




*Energy Saving*

*Reproducibility*

*Shade Continuity*

**Measurement of harmful gaseous substances**

**Dimension unit:**
High concentrations: Vol%
Low concentrations : ppm
(parts per million)

**1 Vol% = 10.000 ppm**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Vol% Nitrogen | 78% | 0,167 | Vol% | | | | |
| Vol% Oxygen | 21% | **0,045** | **Vol%** | **measured by OS 90** | | **450** | ppm |
| other gases | 1% | 0,002143 | Vol% | | | | |
| | 100% | 0,214 | total air | | | | |
| Vol% $H_2O$ | result: | **99,79** | **Vol%** | **steam saturation** | | | |

## Other measuring principles

### Capacitive humidity sensors

The incremental change in the dielectric constant of a capacitive humidity sensor is nearly directly proportional to the relative humidity of the surrounding environment. The change in capacitance is typically 0.2–0.5 pF for a 1% RH change.

Disadvantage:

Not accurate and robust enough in saturated steam close to 99 Vol% $H_2O$