Oxygen Content and Steam Saturation in a Textile Steamer

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 / 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 network 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

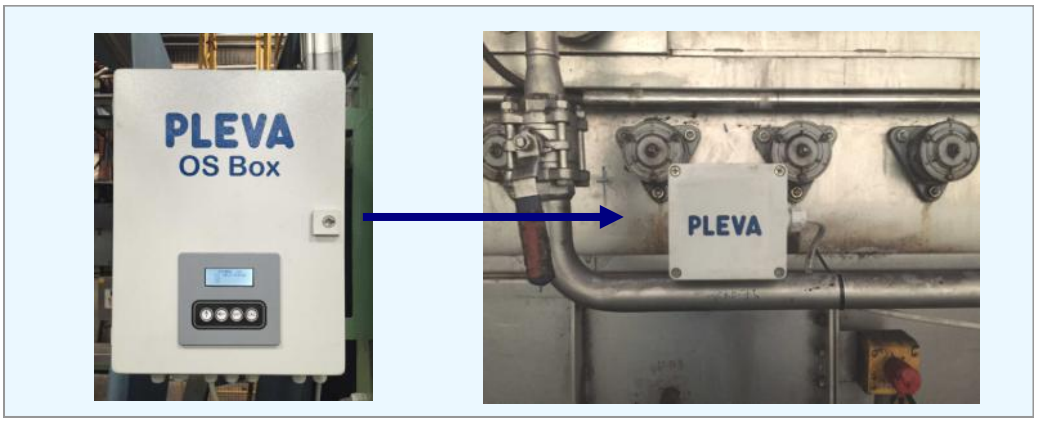
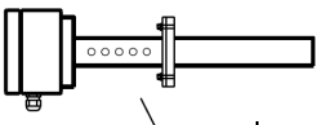


Fig. 1: Oxygen measurement type OS-Box with sensor OS installed at a textile steamer.

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



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.

Energy Saving

Reproducibility

Shade Continuity

Oxygen Content and Steam Saturation in a Textile Steamer with sensor OS

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.

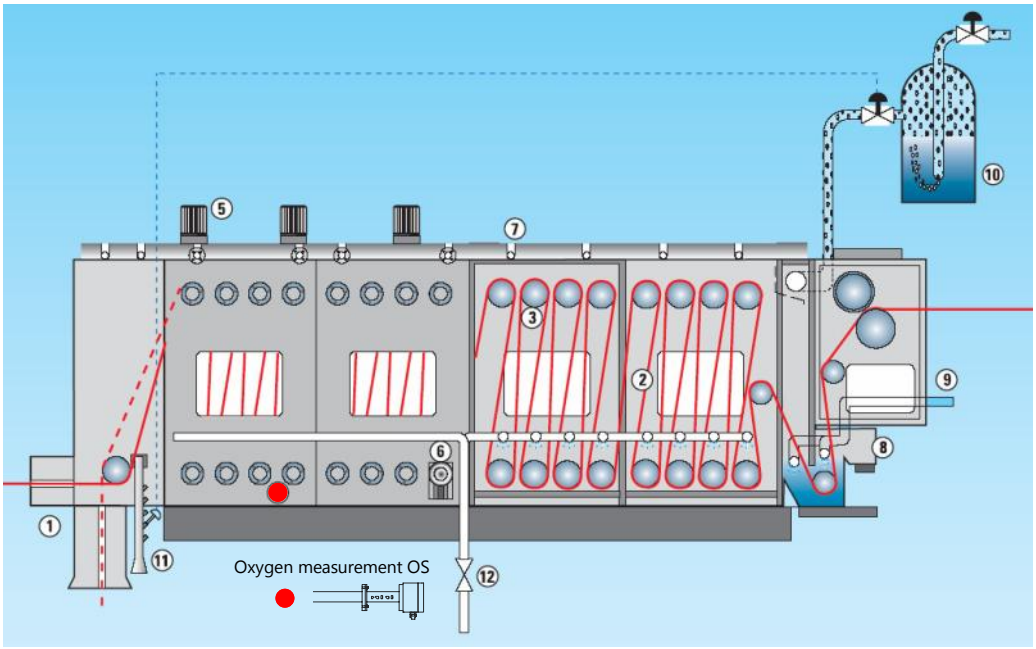


Fig. 2: principle diagram of continuous textile steamer with the position of oxygen measurement sensor OS.

Vol% Nitrogen	78%	0,167	Vol%			
Vol% Oxygen	21%	0,045	Vol%	measured OS	450	ppm
Other gases	1%	0,002143	Vol%			
	100%	0,214	total air			
Vol% H_2O	result	99,79	Vol%	steam saturation		

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