Oxygen delignification

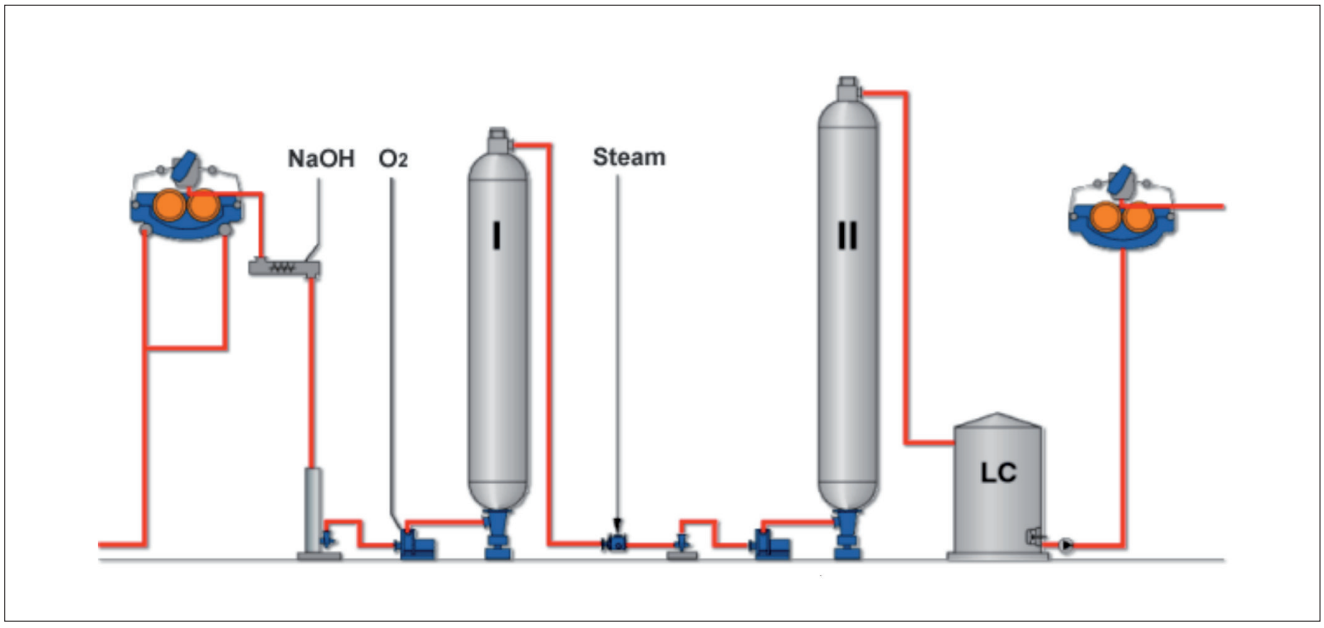

Fig. 1. Two-stage oxygen delignification.

Introduction

Oxygen delignification is a process between cooking and bleaching sequences, where part of the residual lignin left in pulp after cooking is removed using oxygen and alkali. Oxygen delignification is a direct extension to delignification in cooking. The targeted reactions are the oxidation of lignin and breaking it down parts which dissolve in alkali, as well as destroying the coloured groups in lignin and removal of impurities, such as resin. Delignification with oxygen is a more gentle way of reducing the kappa number, than extended cooking. It also lowers bleach plant effluents. Therefore oxygen delignification system is an environmental and an economic investment.

The process

Oxygen is reduced to water in reactions with the organic components, and the organic components are oxidised. Oxygen in its normal state is a weak oxidising agent, and is as such ineffective in delignification. Its oxidizing power can be promoted by raising the temperature and by alkaline conditions.

Figure 1 shows a simplified flowsheet of an oxygen delignification stage. Alkali, oxygen and steam are added to the pulp coming from the washing stage. After a given retention time, the substances formed in the reactions and any residual chemicals are washed out.

The most essential factor in oxygen delignification is to bring oxygen gas into contact with the fibers under alkaline conditions. This means that the pulp suspension should have enough alkaline (OH- ions) to neutralize and dissolve the organic acids, which are generated in oxygen – lignin reactions.

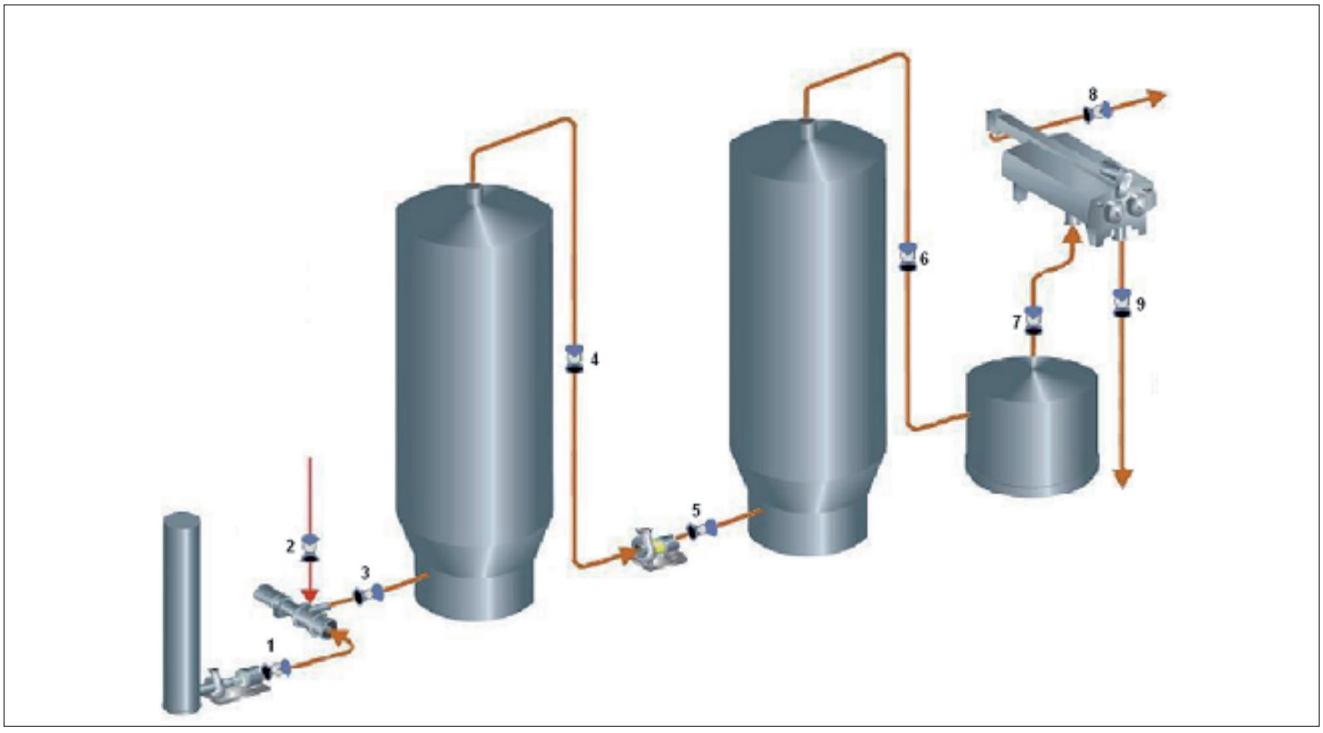

Fig. 2. Typical valves in oxygen delignification.

Oxygen delignification can be done in medium or high consistency. A high consistency oxygen stage is more expensive and more difficult to process than a medium consistency stage. Therefore it is rarely used nowadays.

Medium consistency oxygen delignification can be performed as a single- or two-stage system. The number of stages depends on the kappa number reduction required. A kappa number reduction of less than 50% can be achieved for softwood in a single reactor. Hardwood pulp needs two reactors if a kappa number reduction of over 35% is required.

Table 1 shows typical conditions in oxygen delignification.

Table 1. Conditions in oxygen delignification.

	First stage	Second stage
temperature (°C)	80 - 85	90 - 105
pressure (bar)	7 - 10	3 - 5
retention time (min)	20 - 40	60 - 80

Valves

Figure 2 shows typical valves in the oxygen delignification stage.

Oxygen delignification starts with a medium consistency pump, which pumps the pulp to the oxygen mixer. Medium consistency valve controls the pulp flow. Oxygen and pulp are mixed in the mixer as a homogenous compound. That compound is pumped to the first oxygen reactor though a ball on-off valve.

Control valve controls the pulp flow from the first reactor to the pump before second reactor. Sometimes steam is added in the system before that pump. There is also on-off ball valve before and control valve after the second oxygen reactor.

The pulp is pumped from the oxygen stage discharge tank suitably diluted to the washing equipment.

The washed pulp is then taken to the next process stage, which is usually a buffer storage tower before final bleaching. The fraction of the filtrate to be used for diluting the pulp going to the oxygen stage is cooled to ensure the stock pump operation. The rest of the filtrate is pumped as wash water to the preceding brown stock washer.

Table 2 shows typical valve types and materials (example materials are in brackets) in the oxygen delignification process.

Table 2. Valve types and materials.

Valve	Name	Type	Material	E.g.
1	MC control valve	V-port segment valve	CF8M (316 SS)	RE_A...AJJST
2	Bleaching agent control valve	V-port segment valve	CF8M	RAA...AS
3	Mixer on-off valve	Ball valve	CF8M	M1_A...AP
4	Control valve	V-port segment valve	CF8M	RE_A...AJJST
5	Pump on-off valve	Ball valve	CF8M	M1_A...AP
6	Control valve	V-port segment valve	CF8M	RE_A...AJJST
7	Discharge tank control valve	V-port segment valve	CF8M	RE_A...AJJST
8	Bleached and washed pulp	V-port segment or ball valve	CF8M	RE_A...AJJST
9	Filtrate valve	Triple eccentric disc valve	CF8M	L12A...AA

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