Bleaching storage D_0, D_1 and D_2

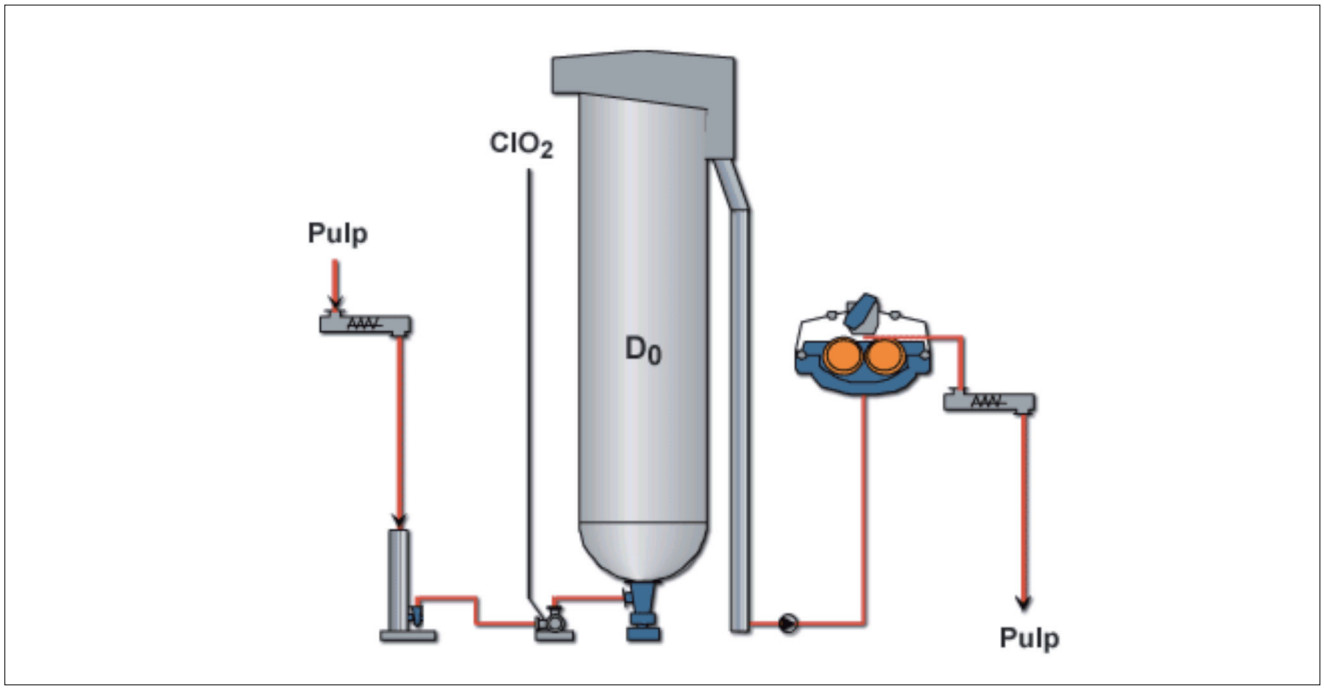

Fig. 1. Initial bleaching stage D_0.

Introduction

Bleaching is usually done in 3-5 sequences with intermediate washing between stages. One or two chemicals are used in one stage. The initial bleaching stage D_0 is more delignifying stage than an actual bleaching stage. Final bleaching stages D_1 and D_2 are more bleaching stages. The construction of all D-stages is usually pretty much identical. Washing or extraction separates stages.

The process

The purpose of the bleaching stage D_0 is to decrease the kappa number after the initial bleaching. The amount of needed chlorine dioxide depends on the lignin content. Unlike the final bleaching stages D_1 and D_2, initial bleaching is done in lower pH, because then the lignin dissolves more efficiently.

Reactions in the D_0 stage decrease the pH, which is why the input pH has to be higher than the intended output pH. The optimal output pH is about 1.5 - 2.5. D_0 is carried out at medium consistency and at a temperature 40 - 70 °C.

Final bleaching is usually done in two stages D_1 and D_2. About two thirds of the total charge of chlorine dioxide in final bleaching is added to the first chlorine dioxide stage and one third to the last stage. Addition of the total chemical charge in one stage does not lead to the desired result. Reaction products have to be removed by an alkali stage or neutralization.

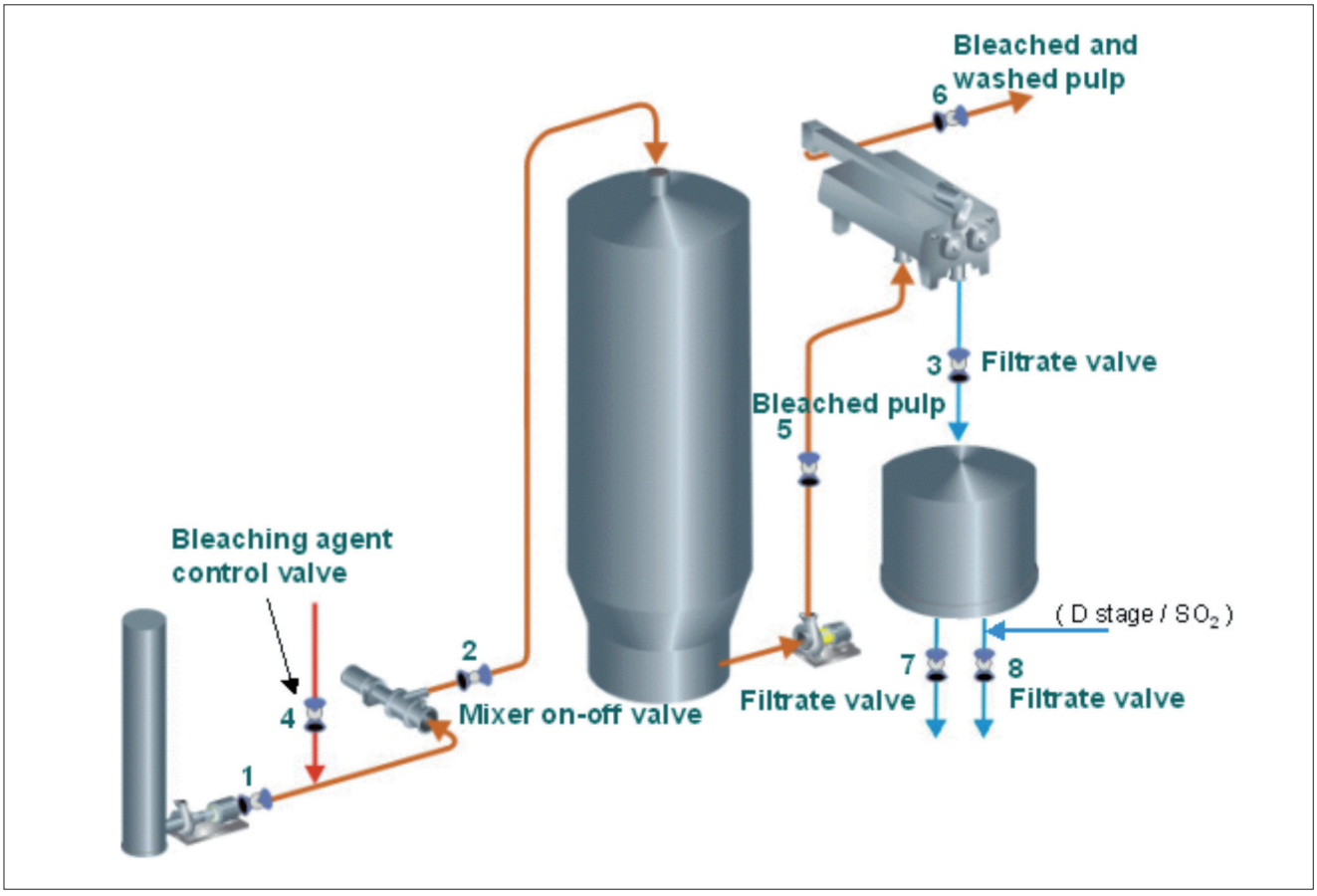

Fig. 2. Typical valves in stage D.

Much higher pH is used in final bleaching compared with the initial bleaching in order to get the best bleaching performance from chlorine dioxide. That is because of the different nature of final bleaching. The biggest difference between stages D_1 and D_2 is a bit higher temperature and longer retention time in the stage D_2.

Optimum pH after final bleaching is 3.5 - 6 because the decomposition rate of chlorine dioxide is then at its lowest. Higher pH will damage carbohydrates and lower the strength of pulp. Table 1 gives the common conditions for D_1, D_2 and D_3.

Table 1. Common conditions in D stages.

	D_0	D_1	D_2
final pH	1.5 - 2.5	3.5 - 5	3.5 - 5
temperature (°C)	40 - 70	55 - 80	60 - 85
consistency (%)	10 - 15	10 - 15	10 - 15
time (h)	0.5 - 1.3	2 - 5	2 - 5

Valves

Titanium is the most common valvematerial in all D stages because of the corrosive chlorine dioxide. In D_0 stage titanium is used in all valves expect for the valve after the washing. That is because chlorine dioxide is used more in initial bleaching compared with final bleaching.

In final bleaching also other materials can be used (e.g. cast austenitic steel) because of the lower chemical dose. Figure 2 shows valves in typical D stage process.

The flow of screened pulp is controlled by MC control segment valve. Chlorine dioxide is added to the process before mixer. Pulp and chemicals are mixed in the mixer as a homogenous compound. That compound is fed to a bleaching tower through mixer on-off valve.

Bleached chemical pulp is fed to the final washing system where chemical left over and water soluble reaction products are removed. After pulp washing it is conducted to the next bleaching stage. Filtrate valves give out used chemicals to treatment. Depending on the process, valves 3, 5 and 6 are not always used.

Table 2 gives valve types and materials. Pipe sizes are nowadays up to 400 mm. Pressure ratings are sized by pump sizes.

Table 2. List of valves.

			Materials		
Valve	**Name**	**Type**	**D_0**	**D_1 ja D_2**	**E.g.**
1	MC control valve	V-port segment	Titanium	Titanium	R2_S...TTTU
2	Mixer on-off valve	Ball	Titanium	Titanium or CK3MCuN**	M1_B…YY M1_B...UC
3	Filtrate valve	V-port segment or triple eccentric disc valve	Titanium	(Titanium or) CK3MCuN**	R1LA...TTTUT LW7_BA...UUUUKT
4	Bleaching agent control valve	V-port segment	Titanium	Titanium	R1LA...TTTUT
5	Bleached pulp	Ball or V-port segment	Titanium	Titanium or CK3MCuN**	RE_A…TTTU RE_A...UUUUT
6	Bleached and washed pulp	Ball or V-port segment	CF8M*	CF8M*	RAA...AS
7	Filtrate valve	V-port segment or triple eccentric disc valve	Titanium	(Titanium or) CK3MCuN**	R1LA..TTTUT LW7_BA...UUUUKT
8	Filtrate valve	V-port segment or triple eccentric disc valve	CF8M*	CF8M*	LW7_BA...AAJAT

* E.g. 316 SS
** E.g. 254 SMO

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