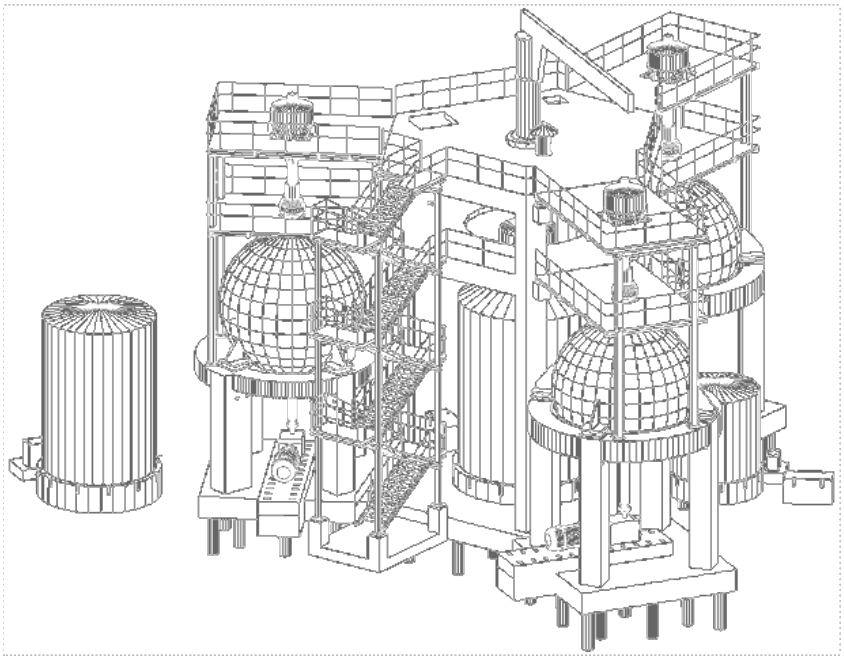
Dissolving Pulp
From
Cotton Linters



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BASIC INFORMATION

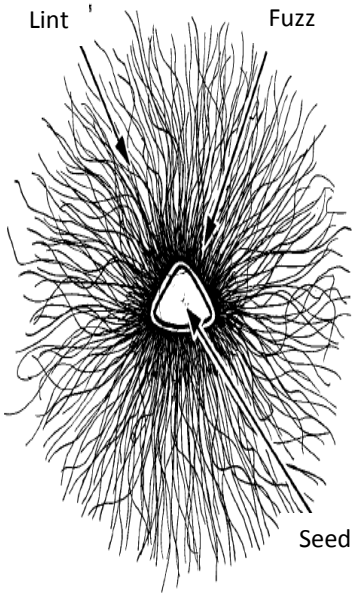
End use & end products

	Manufacturing Process	Product Segment	End Use
DISSOLVING PULP FROM COTTON LINTERS	Etherification	Ethers	Binders CMC Detegents Food Pharmacy Oil driling mud
	Esterification	Viscose	Rayon staple Rayon filament Cord & industry yarn Cellophan and films Sponge products Sausage skin
	Nitration	Nitrates	Explosive Lacquers Celluloid
	Acetylation	Acetates	Acetate filament Acetate sow Acetate mouldings Acetate films
	Coper Solution	Coper Solution	Cuperammonium Fibres Foils
		Other Processing	Filter paper Photographic paper Other specialty papers

The most important consumer of dissolving pulps is the viscose process, which is an estrification carried out in alkalin medium.

Cotton Linters

The impurities present with the cellulose only constitute about 20% of the total composition of raw linters, and 60% of these impurities (seed hulls, sand, foreign matter etc)are easily accessible to removal by comparatively mild physical and chemical methods, which only have a minimal effect on the native cellulose molecule. For this reason, where industrial celluloses are required to be 99% pure and have degrees of polymerization up to Pw 7000, they must be obtained from linters, which additionally have the advantage of greater molecular homogeneity than other industrial cellulose pulps.



Operation	Ginning (lint separation)	One cut	Two cuts	
Product	Lint (Staple cotton)	Mill run	First cut	Second cut
Fiber length	20-50 mm	3.5-5 mm	2.5-6 mm	2 - 3 mm
Fiber diameter	Lengthwise 19µm Crosswise 8 µm	17-27 µm		
Cell wall thickness	2.5-6 µm	6-12 µm		
Cellulose content % bone dry	>86	78-86	83-86	70-83
Purity (*)	← Decreasing			
Chemical reactivity	→ Decreasing			

(*) Absence of seed hulls and lint stumps.

Bleached Cotton Linters

Analytical Characteristics obtainable with bleached linters

Composition of the cellulose	
α-cellulose	99.7%
β-cellulose	0.2%
γ-cellulose	0.1%
Soluble in 10.75% NaOH@20°C @200 cP	0.5%
Carboxyl groups	< 0.02%
Copper number	0.1
Total ash	0.02%
Iron	2 ppm
Silica	<10ppm
Extract in benzene: ethanol	0.03%
Extract in methylene chloride	0.02%
Extract in ether	0.02%
Physical properties	
Viscosity in 1.0% solution in cuprammonium at 20°C	10-800 cP
Intrinsic viscosity [η] (cm^3/g)	280-1400
Degree of polymerization	1000-7000
Brigthness (in the ZEISS-Elrepho at 460 nm in comparison with MgO = 100%)	92%

It should be remembered that for chemical and physical reasons, not all the values indicated may be realized in one material.
For example, low viscosity and high alkali resistance cancel each other out because solution energy decreases with molecular weight; These values serve to give an indication of the possibilities inherent in linters; they do not represent either absolute limits or guaranteed values .

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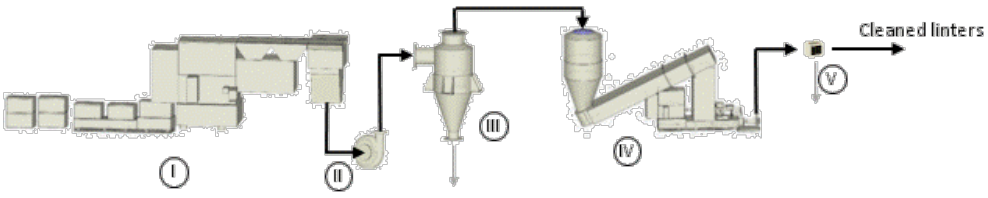
Specific Requirements

The following typical approximate consumption figures can be obtined, referred to 1 ton of pulp:

Consumption	Unit	U_C/t_P
Raw Linters	t	1.2÷ 1.4
NaOH 100%	kg	115
O2 100%	kg	80 ÷ 90
H2O2 100%	kg	18
Na2S2O5 100%	kg	10
H2SO4 96%	kg	30
Process water	mc	90
Demineralised water	mc	30
Steam at 12 Bar	ton	5.5
Electric power	MWh	1.47 ÷ 1.8

Dry Pretreatment

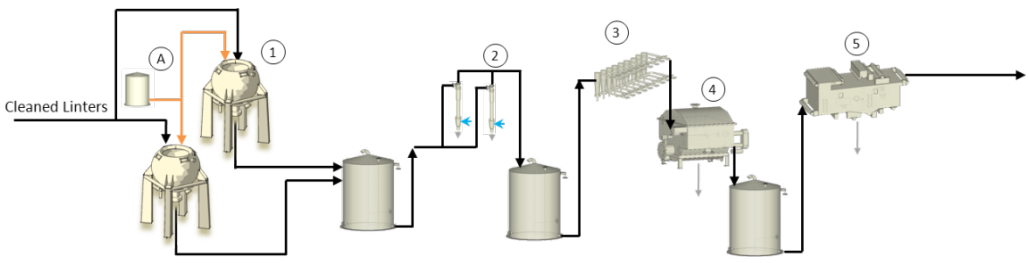
In cotton gin factory or in Oil Mill, if the fibers cut off in the linter are condensed, without further cleaning, into a loose web, they are known as condenser linters: these are mainly used for upholstery purpose.
When, as for chemical processing, a higher degree of purity is required, the fibers are sent through so-called beaters, where some of the impurities are eliminated by beater arms rotating over screens. The product is then known as beater linters.
The use of dry pretreatment unit depends on the degree of cleanness of the raw materials.
The dry pretreatment includes a ball opener, a cyclone separator to remove the largest heaviest contaminants, a beater cleaner that removes dust and other particles bodies and a detector/ extractor that eliminates metals. The handling and conveying will be carry out by pneumatic system.



Dry Pretreatment Section: (I)-Bale Opener, (II)-Fan, (III)-Air Cyclone, (IV)-Beater Cleaner, (V)-Metal Removal

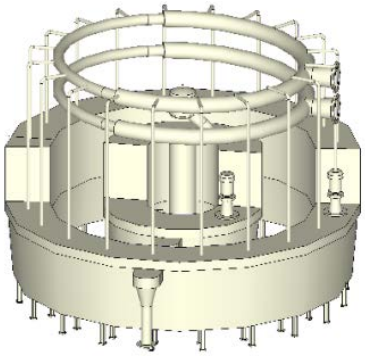
Wet Pretreatment

The purpose of this section is the mixing and homogenizing of the raw materials, as well as their washing in a mild alkali solution. Part of the organic materials are solubilized and separated together with the contaminants "adherent" to the incoming raw material.
The organic matter, in raw linters, corresponding at not less than 40% of the total COD, are removed in pretreatment together with eventual chlorides and part of the silica.



Wet Pretreatment Section: (1)-Turbopulper, (2)-High density cleaner, (3)-Low density cleaner, (4)-Washer drum, (5)-Twin wire press, (A)-Chemicals

Linters is directly fed to a spherical pulper where the linters is mixed with circulating warm water at 80°C and 1 % (based on linters weight) NaOH for washing purposes. The soda will start to dissolve waxes and other protective materials of the linters.
The linters is feed to a Centri Cleaner, where residual contaminants like sand, stones and metal pieces will be separated in the high density and the fine contaminants in the form of mud in the low density cleaners.
The pretreated linters is washed in a Washer drum, by the addition of warm recycle liquor/water distributed via nozzles on the fiber material. The partial washed linters at a dryness of around 6% is sent to the twin-roll press. The pressure between the discs is controlled by a hydraulic system and the final dryness of the Linters can be settled to around 40% dryness.



Delignification

Pretreated linters is mixed with chemicals and recycled liquor in the needed amount for an effective delignification in a special mixing device.
Linters and chemicals suspension at an established consistency is heated and is then pumped over to the continuous delignification system. Linters/chemicals ratio is controlled by the input from the above mentioned weighing system.
A volumetric pump type Mohno, sends to the pressurized Turbopulper a controlled amount the linters/chemicals suspension.

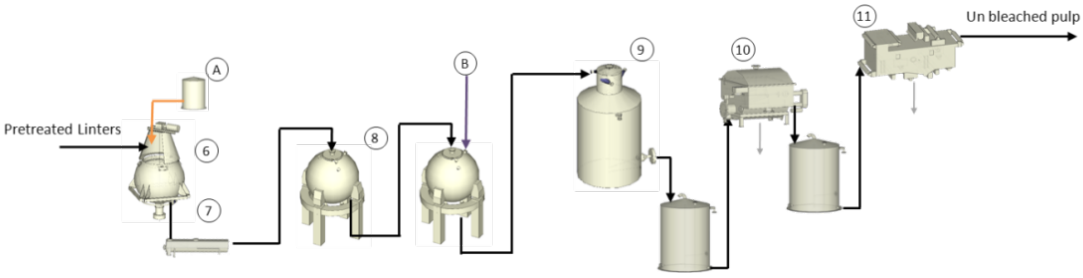


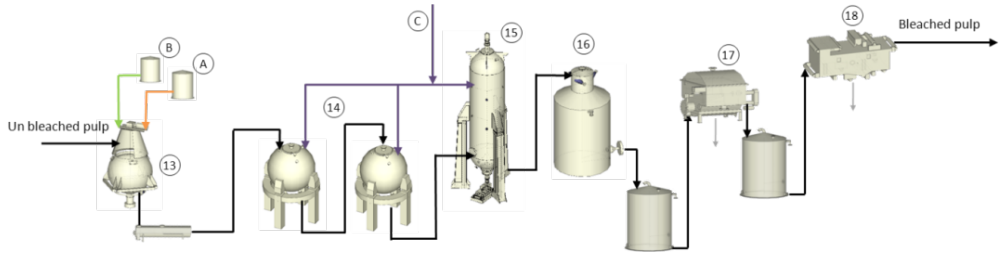
Fig. 6 Delignifications Section : (6)-Mixer, (7)-Pump (8)-Turbopulper, (9)-Bolow down, (10)-Washer drum, (11)-Twin wire press, (A)-Chemicals, (B)-Oxygen

The fresh oxygen is mainly added in the second pulper and will act in the optimal condition created by the efficient agitation of the pulp that has to guarantee the best mass-transfer gas/fiber that is the basically condition for the process.
The heating up of the suspension in the Turbopulper as well as in the mixing pulper is obtained by an indirect heating system inside of the reactors.

Steam condensate can then be recovered and used for heating up the chemicals solution and finally pumped back to the water boiler system reducing to the minimum the make-up water for the boiler.
Finally, the unbleached pulp is sent to blow tank and then washed in a similar washing system in the pretreatment stage. The spent liquor from delignification of linters contains a high amount of residual alkali and has a high pH.

Bleaching

The bleaching stage includes a two Turbopulper and one oxygen reactor as main equipment. The unbleached pulp is mixed with caustic soda and hydrogen peroxide in a special mixer and sent to the pressurized Turbopulper and then in Bleaching tower to complete reaction. The average residence time for linters between entry into Pulper and exit from reactor is about 90 minutes.
The mechanisms of oxygen injection and blow down are similar to the delignification section



Bleaching Section : (13)-Mixing device, (14)-Turbopulper, (15)-Bleaching Tower, (16)-Bolow down, (17)- Washer drum, (18)- Twin wire press, (A)-NaOH, (B) H2O2 , (C)-Oxygen

Industrial application

Cellulosa 2000 mill (Crotone)- 60 tons/day TCF cotton linters

Delignification

Bleaching

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