

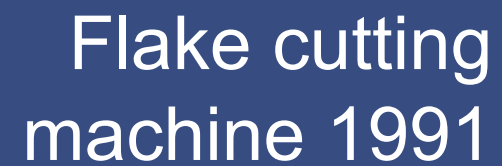


Bowas-Induplan Chemie Ges.m.b.H.

Sterneckstrasse 55
A-5020 Salzburg
AUSTRIA

Tel.: +43/662/877671-0
E-Mail: office@bowas.com

Developments in Dense Nitrocellulose Nitration



CELLULOSE PREPARATION (dense)

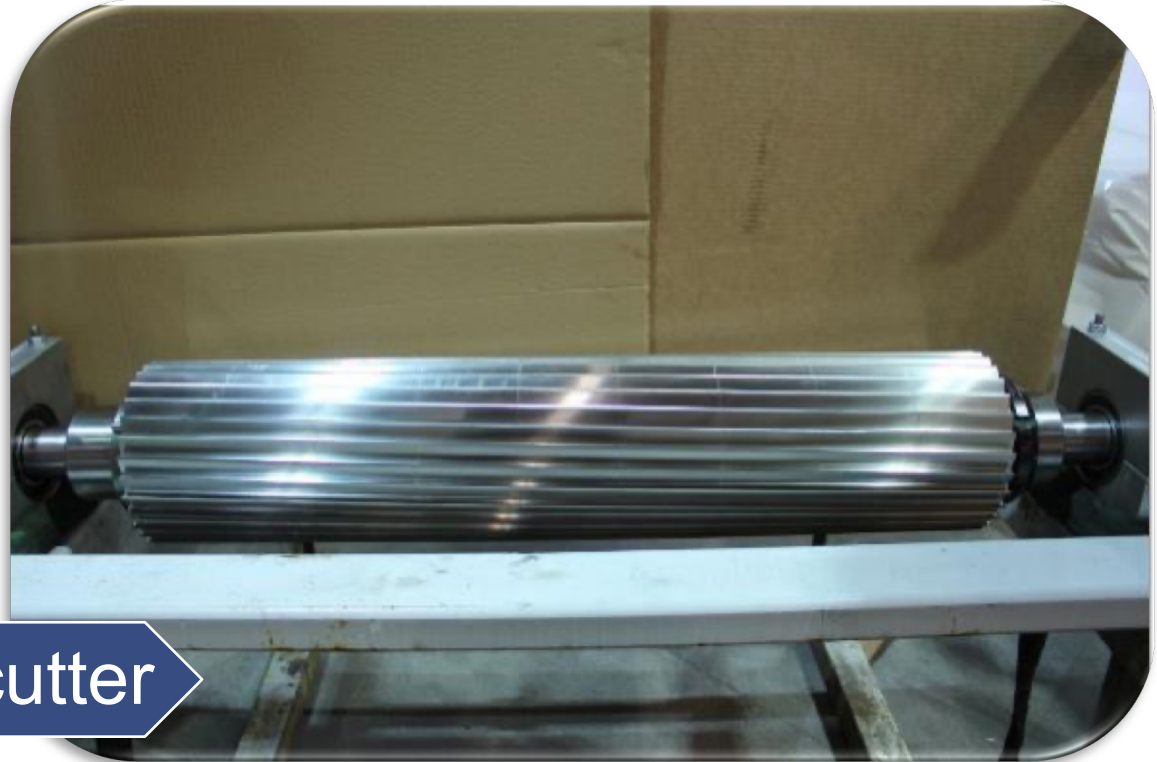


COMPONENTS OF CUTTING MACHINE

longitudinal cutter



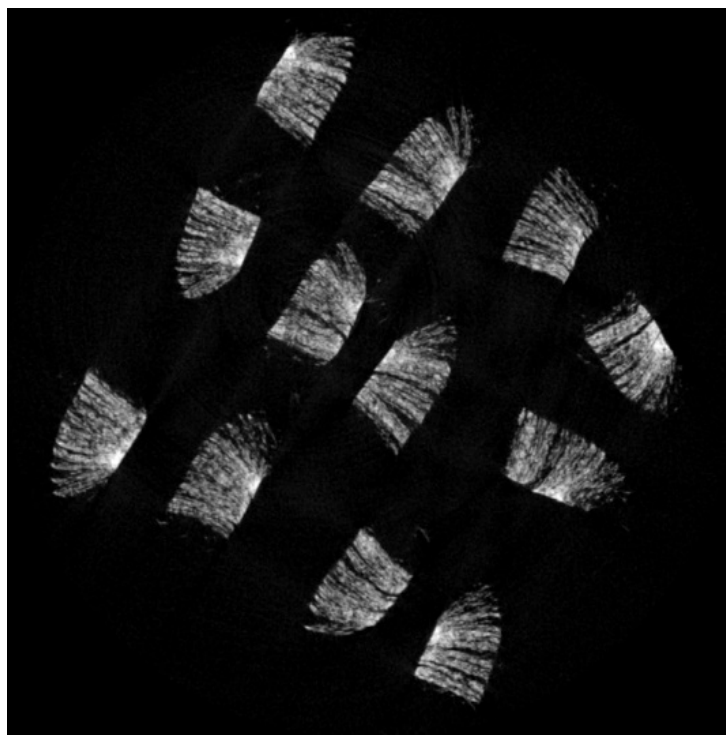
cross cutter



CAPACITY INCREASE: „Fluffy“ vs „Dense“ NC

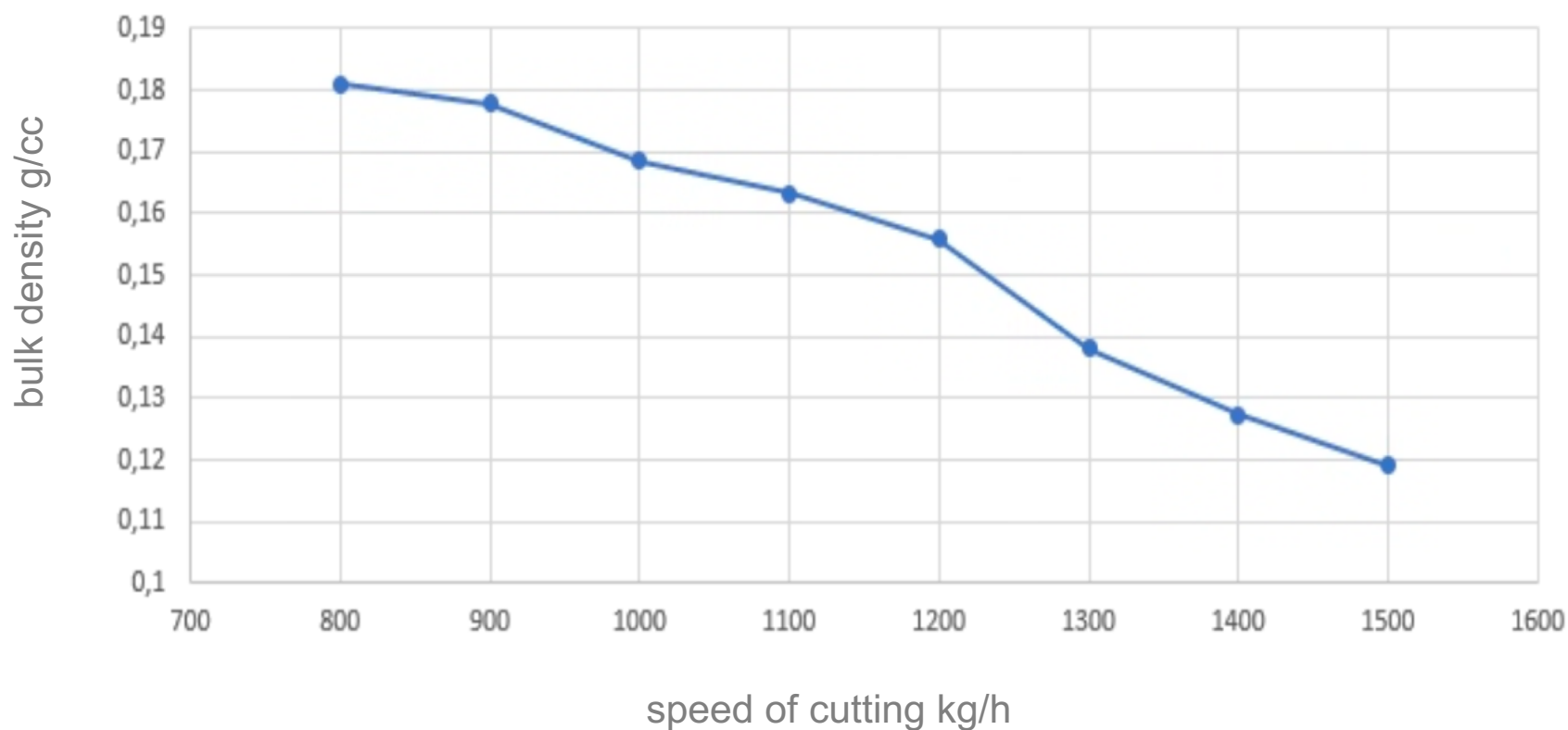
	FLUFFY	DENSE	CAPACITY INCREASE
NITRATION			
Acid : Cellulose Ratio	50 – 60 : 1	20 – 25 : 1	50 %
Nitration Time	35' – 45'	60' – 90'	
PRESSURE STABILISATION			
Pulp Concentration	5% - 6%	10% - 18%	100 %
REFINING			
Pulp Concentration	5% - 10%	10% - 11%	50%

SLIVERS SHOWING A FAN-LIKE EDGE



BULK DENSITY vs. CUTTING SPEED

slivers 0.8 mm width



PICTURE OF PILOT PLANT



PULPS INVESTIGATED

	Grammage	Density	Sheet Thickness
	[g/m ²]	[g/cc]	[mm]
BSC	800	0.74	1.1
Crystal HD	800	0.85	0.94
Crystal	800	0.75	1.1
Crystal LBW	720	0.75	1.1
Crystal 2C	800	0.75	1.1
Temalfa	570	0.70	0.8
Nitranier J	720	0.47	1.5
Nitranier J HD	720	0.52	1.38



Colour comparison industrial standard vs our sample

NITRATION QUALITY COMPARISON

	Solubility in Ethanol + 5% E-A		Turbidity	
	Delaminated	Not Delaminated	Delaminated	Not Delaminated
2.7 x 6 mm chips	154	185	49	91

RESIDUAL ACIDITY, EFFECT OF DELAMINATION

Cellulose / NC	After Nitration	Boiling 4 h at 110°C	At 130°C	After 45 min. at 130°C
Ultranier J, 1.0 mm sliver, Grade B	0.403 %	0.145 %	0.104 %	0,069 %
Buckeye N5, 1.0 mm sliver, Grade B	0.287 %	0.105 %	0.067 %	0.054 %

ACIDITY, EFFECT OF MIXED ACID COMPOSITION

Cellulose / NC	After Nitration	Boiling 4 h at 110°C	At 130°C	After 45 min. at 130°C
U-J, 0.5 mm sliver. Grade A, High Nitric	0.111 %	0.029 %	0.025 %	0.024 %
U-J, 0.5 mm sliver, Grade A, Low Nitric	0.28 %	0.057 %	0.050 %	0.037 %
N-5, 1.0 mm sliver, Grade B, High Nitric	0.287 %	0.105 %	0.067 %	0.054 %
N-5, 1.0 mm sliver, Grade B, Low Nitric	0.338 %	0.121 %	0.091 %	0.075 %
Lint, 1.0 mm sliver, Grade A, High Nitric	0.173 %	0.015 %	0.010 %	0.007 %
Lint, 1.0 mm sliver, Grade A, Low Nitric	0.377 %	0.042 %	0.025 %	0.023 %

IN CONCLUSIO

**Important increases in capacity can be achieved
by switching or partially switching nitration to a dense type process.**

Nitration with high nitric acid content; > 50%

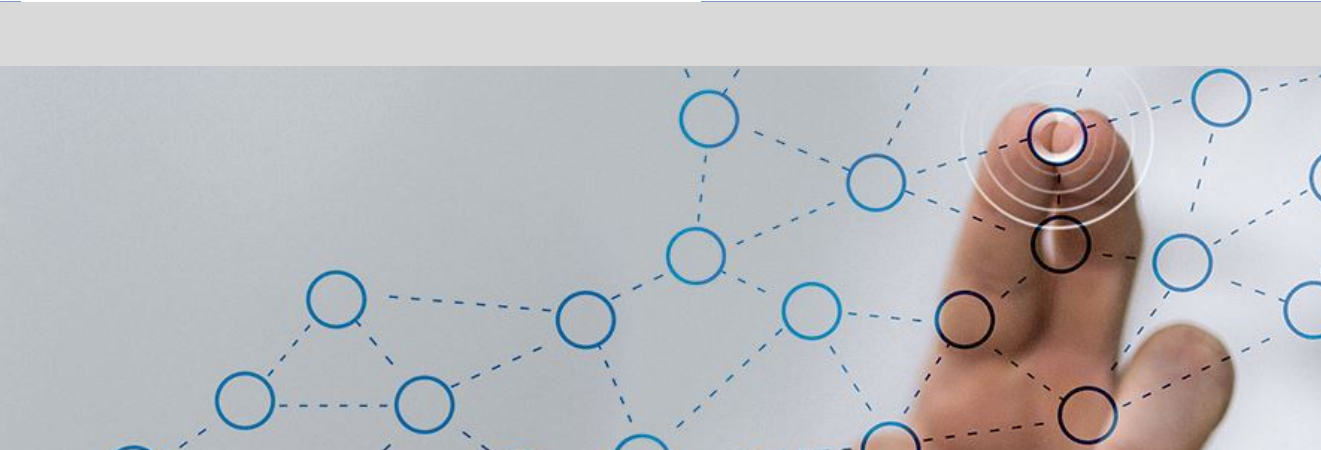
- Homogeneous nitrogen content is easily achieved in nitration
- Good Ether-Alcohol solubility is achieved.
- Good Alcohol solubility is achieved
- Delamination of the cellulose slivers is not required
- Agglomerates content is high

Nitration with lower nitric acid content, < 40%

- Homogeneous nitrogen content can only be achieved with significant delamination
- Tuning of nitration conditions is required
- If both of the above, good Ether-Alcohol and good Alcohol solubilities are achieved
- Agglomerates content is low (< 5%)

Given the increased requirement for propellant grade NC we are of the opinion that consideration should be given to the dense process to increase capacity of existing plants.

- THANK YOU FOR YOUR ATTENTION -



Contact

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