TECHNICAL BULLETIN

LIGNIN-MODIFIED PHENOLIC RESINS FOR PLYWOOD

Borregaard

STANDARD PLYWOOD PF RESIN (NO LIGNIN) FORMULATION

Short characterization: MR (F/P) = 2.2, MR (NaOH/P) = 0.6

Raw material	Dry solids, %	Amount (g)	Solids (g)	Amount (mol)	Comments
Water		147,42			Tap
Formaldehyde	50	421,62	210,81	7,02	
1st Sodium hydroxide	50	38,19	19,10	0,48	
Phenol	99	301,02	298,01	3,17	
2nd Sodium hydroxide	50	38,22	19,11	0,48	
3rd Sodium hydroxide	50	76,68	38,34	0,96	
Total		1023,15			

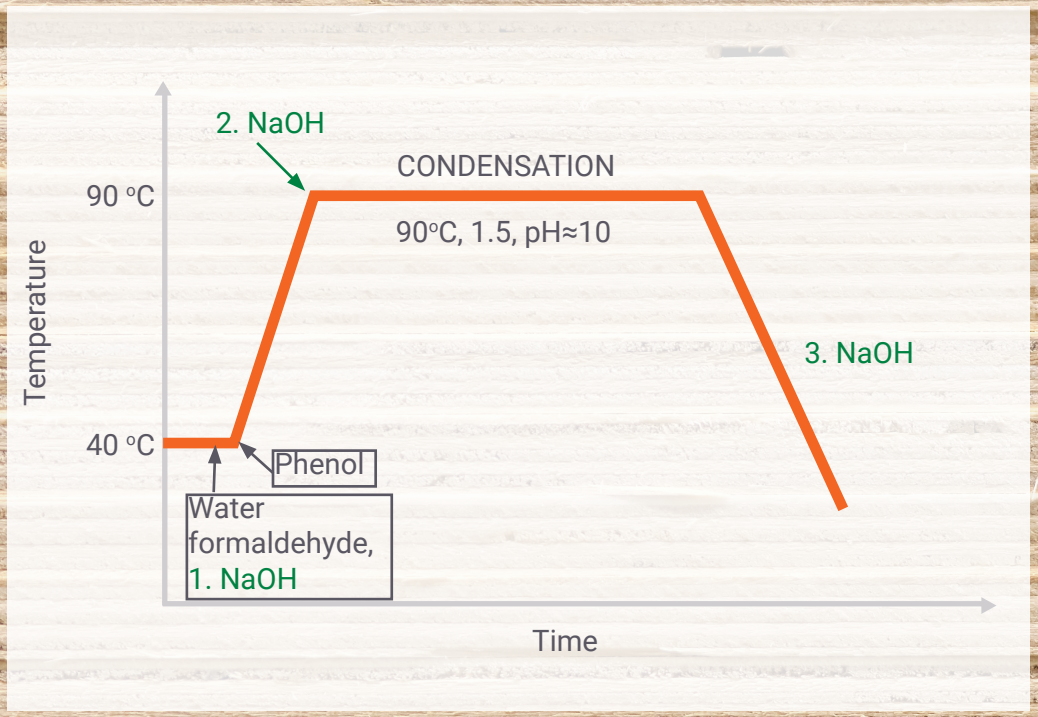
PROCEDURE

1. Water, 50 % formaldehyde and 1st portion of sodium hydroxide 50% w/w are mixed at 40°C.

2. Add phenol and raise the temperature to 90°C.

3. When the temperature is reached, add the 2nd portion of sodium hydroxide. The mixture is held at 90°C for 90 minutes.

4. The mix is cooled on ice. When T < 55°C, add the last amount of sodium hydroxide.



PLYWOOD LPF RESIN FORMULATION

Calculated with Borresperse Na 890 (powder), with formaldehyde 50%.

Short characterization: MR (F/P+LS) = 2.2, MR (NaOH/P+LS) = 0.6

Raw material	Dry solids (%)	Total amount (g)	Solids (g)	Amount (mol)	Comments
1st Water		80,00			Tap
Borresperse Na 890	Min. 93	73,85	69,42	0,39	Powder
1st Formaldehyde	50	66,80	33,40	1,11	
1st Sodium hydroxide	50	12,05	6,03	0,15	
2nd Water		120,87			Tap
Phenol	99	306,33	303,27	3,22	
2nd Sodium hydroxide	50	39,95	19,98	0,50	
2nd Formaldehyde	50	417,28	208,64	6,95	
3rd Sodium hydroxide	50	40,05	20,03	0,50	
4th Sodium hydroxide	50	82,77	41,39	1,03	
Total		1239,95			

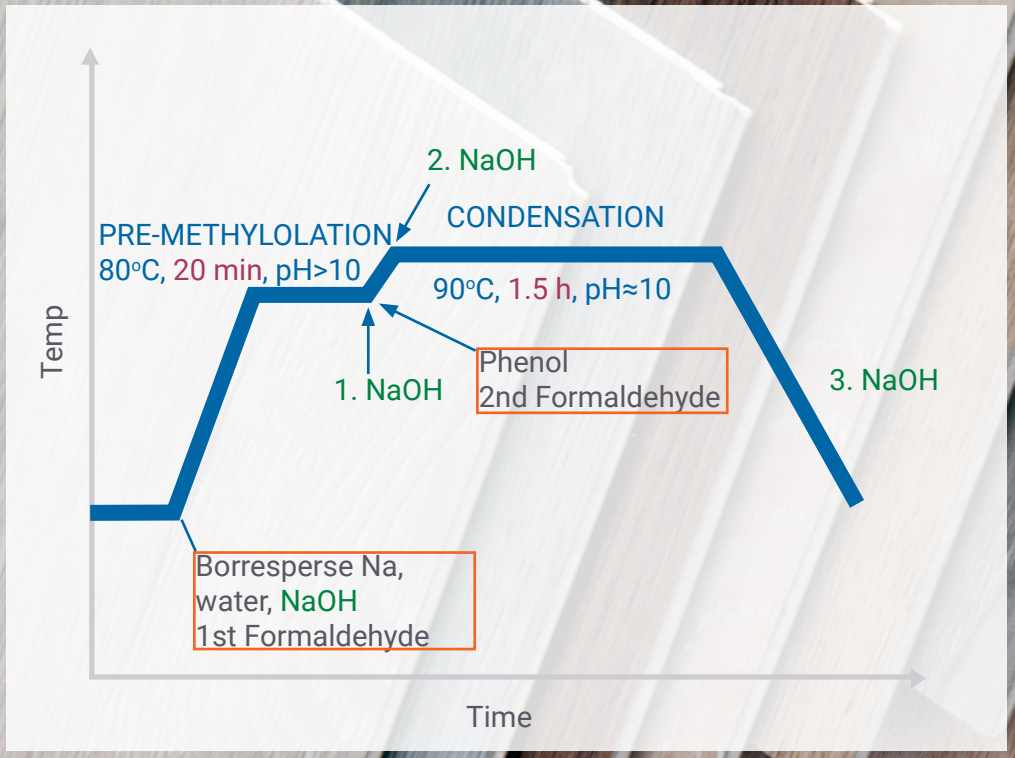
PROCEDURE

1. Borresperse Na 890 is dissolved in water and mixed at 40°C until dissolved.

2. 1st portion of NaOH is added to work under basic conditions (pH > 10). The lignin is pre-methylolated at 80°C with 1st portion of 50% formaldehyde for 20 minutes under vigorous stirring. At the end of the pre-methylolation the 2nd portion of water is added.

3. Phenol, 2nd portion of sodium hydroxide and 2nd portion of 50% formaldehyde are added. The temperature is raised to 90°C. Add 3rd portion of sodium hydroxide when the temperature has reached 90°C. Keep the mixture at 90°C for 90 minutes.

4. When the condensation is done, the resin is chilled to 55°C before the last addition of sodium hydroxide. Cool to room temperature.



Typical values measured in the final resins:

Property	Std. Plywood PF resin	Plywood lignin based PF resin (LPF)
pH	11.3	11.2-11.4
Viscosity (at 25°C)	210 mPa*s	250-350 mPa*s
Viscosity (at 20°C)	290 mPa*s	350-450 mPa*s
Dry content	48%	48%
Free formaldehyde	0.7%	1.3-1.5%
Free phenol	0.3%	0.1%