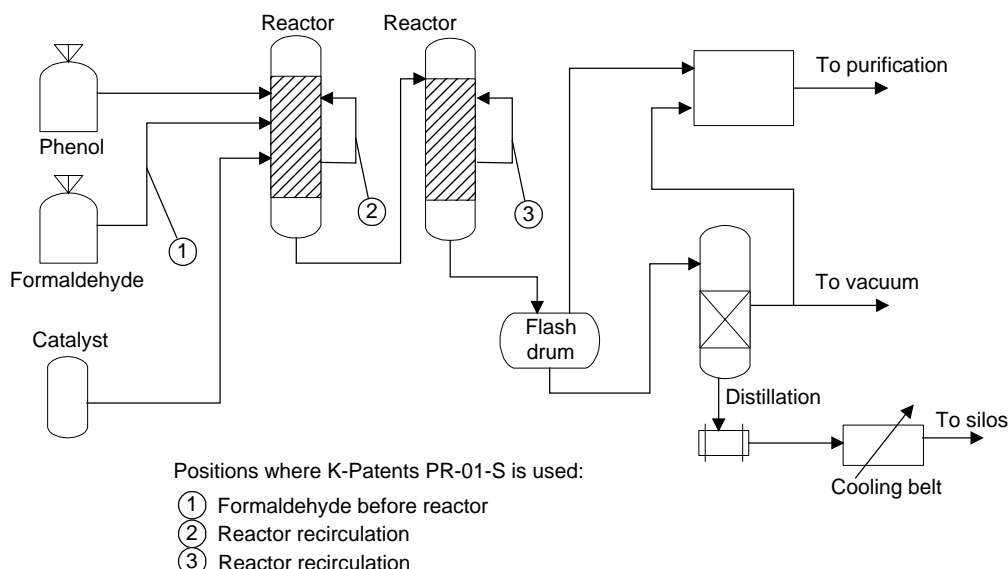


### Phenolic Resins



### Phenol (C<sub>6</sub>H<sub>5</sub>OH), Formaldehyde (HCHO)

Typical end products/ uses

Mouldings, coatings, bondings

See also

Formaldehyde 4.02.02  
Pheno Process 4.02.03

### Introduction

Phenolic resins are formed by the reaction of phenol and formaldehyde. In case the basic conditions and an excess of formaldehyde are used, the result is a resole phenolic resin. If a catalyst and an excess of phenol are used, the result is a novolak phenolic resin.

### Application

Novolak Resins:

In a conventional novolak process, molten phenol is placed into the reactor, followed by a precise amount of acid catalyst. The formaldehyde solution is added at a temperature of near by 90°C (194°F) and a formaldehyde-to-phenol molar ratio of 0,75:1 to 0,85:1 should be achieved. For safety reasons, slow continuous or stepwise addition of formaldehyde is preferred over adding the

entire charge at once. The reaction is completed after 6-8 hours at 95°C (203°F); volatiles, water, and some free phenol are removed. Because free phenol content in the resin is a main determinant of resin properties, the final phenol content is monitored carefully. Then the product is either recovered, neutralized and recovered or converted to a desired form or product.

Resole Resins:

Like the novolak processes, a typical resole process consists of reaction, dehydration, and finishing. Phenol and formaldehyde solutions are added all at once to the reactor at a molar ratio of formaldehyde to phenol of 1,2-3,0:1. In the reaction phase, the temperature is held at 80-90°C (176-194°F) and the reaction lasts 1-3 hours. Solid resins and certain liquid resins are dehydrated as quick as possible to prevent overreacting. The end point of dehydration is found by manual determination of a specific gel-time, which decreases as the polymerization advances. When the desired end point is reached, the contents of the reaction vessel are cooled and after that, the

resin is refrigerated until it is used. In case of a liquid form resin, it is recovered as 40-50wt% water solution.

### Installation

K-Patents Process Refractometer PR-01-S is used to measure formaldehyde concentration before the reactor. The concentration is about 20% and the temperature is 90°C (194°F). The other installations are in reactor recirculation to control the reaction degree and to determine the amount of the water at the end of batch.

K-Patents PR-01-S can offer an accurate and reliable measurement. By using special Yag-prism as high refractive index as 1,63 can be verified. The PR-01-S is the only refractometer that can measure so high R.I. In both applications the continuous measurement offers valuable real-time information for process control. In all applications prism wash by steam cleaning system is recommended.