

Unsaturated Novolaks Curable by Addition Polymerisation

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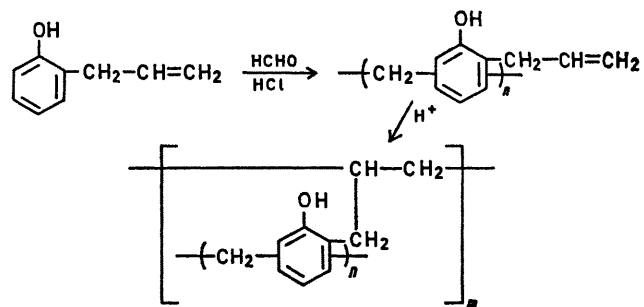
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Summary By condensing 2-allylphenol with formaldehyde we have synthesised a new novolak which can be cured by addition polymerisation without the use of high temperature and pressure.

With an acid catalyst, condensation of excess phenol with formaldehyde forms products which are generally called novolaks. As novolaks contain no reactive $-\text{CH}_2\text{OH}$ group they are incapable of crosslinking on their own. However, they are readily cured with hexamethylenetetramine which under suitable conditions liberates formaldehyde and ammonia which bring about crosslinking by a complex mechanism. This method generally requires high temperatures and pressures for good curing efficiency. The resulting products are rigid and hard but tend towards brittleness unless modified with suitable fillers.

If a phenol with an unsaturated substituent in the benzene ring is condensed with formaldehyde, it should be possible to make the novolaks so obtained cure by an addition mechanism to a more flexible network than conventional novolaks. We have succeeded in synthesising a new novolak which can be cured at room temperature or below and at atmospheric pressure. This new novolak was prepared from condensation of excess 2-allylphenol with formaldehyde in the presence of hydrochloric acid by a method similar to that used for conventional novolaks. This new novolak is not stable in the atmosphere, changing from a pale yellow viscous resin to a reddish resin within a few hours: its molecular weight is 672.

When concentrated sulphuric acid is added to a solution of this novolak in methylene chloride, gelation occurs almost instantaneously. This gelation is probably a result of addition reactions initiated by sulphuric acid *via* a cationic mechanism:



That addition *via* the allylic double bond has taken place is supported by the formation of poly-2-allylphenol when concentrated sulphuric acid is added to a solution of 2-allylphenol in methylene chloride. The i.r. spectrum of this polymer showed the absence of the allylic double bond.

Preliminary investigations revealed that the weight of gel obtained from a solution of the new novolak is highly dependent on the weight of concentrated sulphuric acid used.

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