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NOTE

Synthesis, characterisation and curing of furan resins

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Abstract : The furan resins have been synthesized by condensation of furfuryl alcohol with anisaldehyde/salicyldehyde and furfuraldehyde with furfuryl alcohol/*p*-cresol using acid or base or metal salt as catalyst. These resins have been characterized by Fourier Transform Infra-red spectra (FTIR) and cross-linking of these resins are accomplished by using various curing agents. These resins find extensive application in spandex fibers, laminates, lining for rocket fuels, abrasive wheels etc.

Keywords : Furan resins, curing.

Preparation of bisphenol-A–furfural resin[1,2] and its application in laminating, casting etc. have been used as matrix for composites. Polycondensation of bisphenol-C and furfural has been carried out in the presence of basic and acidic catalysts under various reaction conditions[3].

The present investigation aims with the synthesis, characterization and curing of aforesaid furan resins.

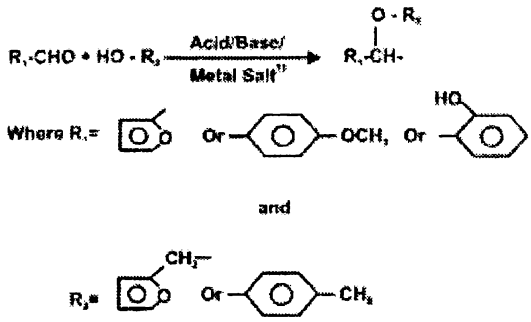

Table 1. Base catalysed FA-AN/SA and FU-FA/p-C condensation

Resin sample	Molar ratio	Catalyst and medium	Colour change	Reaction temp. (°C)	Reaction time (h)
FA-AN	2 : 1	5% each (NaOH and H_2O of the wt. of FA)	No change in colour	100	3
FA-SA	2 : 1	5% each (NaOH and H_2O of the wt. of FA)	Light yellow	90	3
FU-FA	1 : 2	5% each (NaOH and H_2O of the wt. of FA)	Yellow to light red	80–100	2
FU-p-C	1 : 2	5% each (NaOH and H_2O of the wt. of FA)	Colourless to red	80–100	3

Experimental

All monomers were of good quality and most of them were purified by vaccum distillation. The catalysts used were purified by usual methods. Most of the catalysts are inorganic salts and weighed accurately before use.

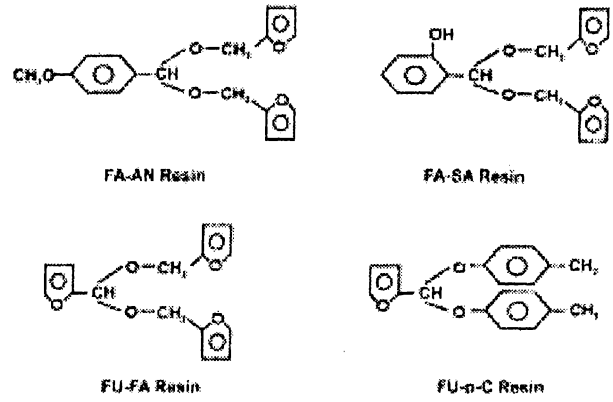

Fig. 1

Table 2. Curing features of different resin samples

Resin sample	Quantity of resin	Curing agent	Amt. of curing agent (g)	Curing temp. (°C)	Curing time (min)	Colour
FA-AN	3 g	$CuCl_2$	0.60	100	3	Dark tin red
	3 g	$HgCl_2$	0.60	100	20	Dark tin red
FA-SA	3 g	$CuCl_2$	0.60	100	38	Dark red
	3 g	$HgCl_2$	0.09	100	25	Dark tin red
FU-FA	6 ml	$CuCl_2$	0.18	80	2	Cherry red
	6 ml	$HgCl_2$	0.18	80	25	Dark red
FU-p-C	3 g	$CuCl_2$	0.06	50	22	Greenish
	3 g	$FeCl_3$	0.06	195	35	Black

Resin was prepared by taking freshly distilled colourless furfuryl alcohol (0.02 mol, 1.96 g); anisaldehyde was added to it dropwise and 5% each (NaOH and water of the weight of FA) with stirring. After some time it became homogenous and this mixture is heated on water bath at 100 °C for 1 h. There is no change in colour and the resin formation is observed in 3 h.

Table 3. FTIR data of various uncured and cured resin samples

Resin sample	Band (cm^{-1}) Uncured	Cured
FA-AN	3012, 1461–1427, 1600, 1577–1511, 1317–1262, 835	1599–1511, 1317–1262, 1076
FA-SA	3010, 3336, 1622–1551, 1457, 1581–1460, 1223–1194	3010, 3446, 1619–1560, 1458, 758
FU-FA	1280–1221, 1671, 1149, 1149–1011	1276–1061, 1659, 3639–2924
FU-p-C	3024, 2921–2734, 1615–1599, 1567–1471, 1471–1394	3290–2919, 1662–1594, 1540–1487, 1487–1200, 965–809

The other resin sample listed in Table 1 was synthesized following the method as described above under the reaction conditions also outlined in it.

Curing of different resin samples with various curing agents are summarized below in Table 2 along with certain details.

Results and discussion

The resin samples presented in Table 1 are soluble in most of the common organic solvents. The softening range, percentage yield of the resin samples of each series are found to increase in the ratio of monomers concerning.

The data given in Table 3 confirm the structure of resin samples bearing acetal group (Fig. 1). It is also obvious that cured resin samples exhibit tremendous change in terms of shape and peak portion in comparison with uncured resin. This is indicative of strong interaction between resin and metal salts.

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