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RADIATION RESISTANCE OF GLASS REINFORCED EPOXY-RESINS

by

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The radiation stability of different, pure and mineral filled epoxy resin compositions has been reported[1]. From this study we have concluded that the following resins and curing agents give the best results:

Resins: EPN 1138 - X33/1020 - Araldite F
Curing Agents: HT 971 - HT 972 - HY 906

In this report results are given using epoxy resins with the following compositions:

Resin	Hardener	Percentage of glass by weight
X33/1020	HT 972 27 phr	61,3 %
X33/1020	HY 906 110 phr	61,3 %
Araldite F	HT 972 27 phr	67,2 %
X33/1020	HY 906 110 phr	-
Araldite F	HT 972 27 phr	-
Araldite F	HY 906 110 phr	-

On five specimens of each resin system and dose level the flexural strength was measured.

The dimensions of the samples were 125 x 12,7 x 3 mm.

1) G. Pluym and M. H. van de Voorde - ISR-MAG/67-3

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The data derived from these measurements are presented in figure 1. It can be concluded that:

1) The resin composition X33/1020/DDM/Glass is more radiation resistant than F/DDM/Glass. The same conclusion was drawn in report[1] with the corresponding unreinforced resin compositions.

   In general, we can thus conclude that the basic epoxy structure X33/1020 is always more radiation resistant than the F structure, independent of:

   a) the type of curing agent used (compare curve (5) with (7);

   b) the glass-fiber addition (compare curve (2) with (4).

2) Glass-reinforced epoxy resins are much more radiation resistant than those without. Compare curves (3) with (5) and (4) with (6).

   At 5 x 10^9 rad, the mechanical resistance of all unreinforced epoxy resin compositions is very low while, at this level, the glass-reinforced ones are not seriously damaged.

3) The curing agent DDM seems to give more radiation resistant compositions than the MNA. Compare the curves (2) with (3) in the figure. Similar results are obtained in report[1] on unreinforced systems.

4) Results reported elsewhere[2] on the radiation resistance of glass-reinforced X33/1020/MNA differ from ours. This may be due to the difference in radiation fields used. Curve 1 was obtained using γ-rays from a spent fuel element facility. We irradiated in a reactor (25 % neutrons and 75 % γ's), which resulted in curve 3.

2) M. J. Price and R. Sheldon - RHEL/R 105

The difference can be qualitatively explained by the presence of boron in the glass, which has a high cross-section for thermal neutrons. The α particles from the (n. α.) reaction have an energy of 2,5 MeV, which will be locally absorbed and which will, therefore, rupture a high amount of chemical bonds.

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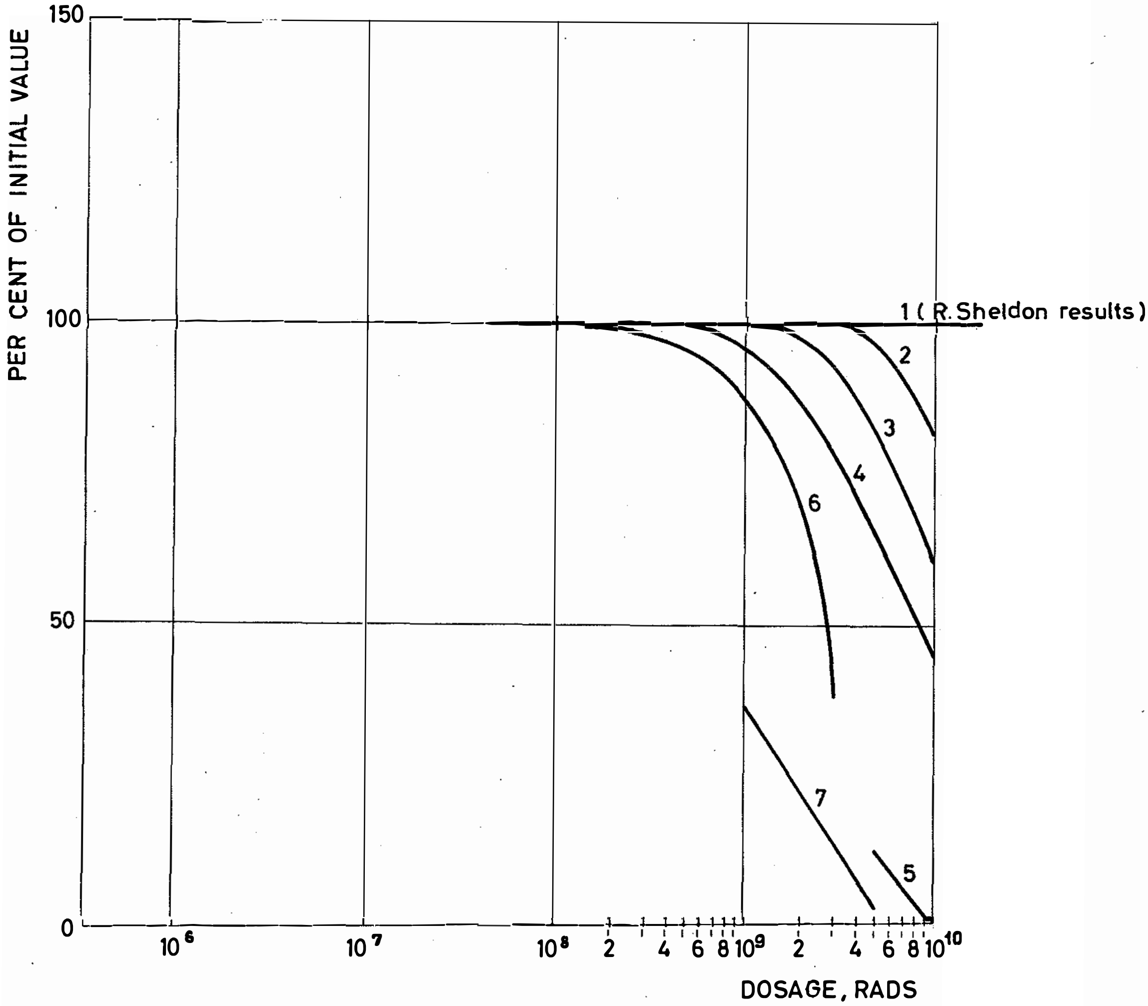

CURVE NO.	PROPERTY		INITIAL VALUE	COMPOSITION
1	FLEXURAL STRENGTH		32,6 kg/mm²	X 33.1020 + MNA + BDMA + GLASS
2	"	"	39,4 "	X 33.1020 + DDM + GLASS
3	"	"	36,8 "	X 33.1020 + MNA + BDMA + GLASS
4	"	"	39,1 "	F + DDM + GLASS
5	"	"	13,3 "	X 33.1020 + MNA + BDMA
6	"	"	17 "	F + DDM
7	"	"	11,8 "	F + MNA + BDMA

Fig. 1

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