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Rheological Behavior of Isothermal Cured Epoxy/1,4-Diaminobenzene Systems

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Abstract

A novel curing agent (1,4-diaminobenzene) was used to enhance behavior of the epoxy resin system. The effect of the curing agent content (12 to 21 wt%) subjected to the isothermal curing temperatures at 80 °C to 110 °C were performed. Results indicate that the gel time was effected slightly on the viscosity when the curing temperature was higher than 90 °C and curing material consist over from 18wt %. These results explain that reaction rates caused by higher curing temperature.

Keywords: Rheological, Curing agent system, Epoxy system; Curing temperature

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Introduction

Epoxy polymer adds are usually utilized as polymeric frameworks in elite composites [1]. polymer resins are utilized broadly d to their low shrinkage, high glue quality, movable practical construction and well mechanical execution, particularly in arenas that need great quality and amazing execution, for example, wind cutting edges and advanced plane design [2–4].

Adding of silica nanoparticle enhanced the matrix structure of epoxy resin such as high matrix structure [5]. There are many studies required in the creation procedure, from the choice of crude materials to the fabrication of the completed items. Of the many strides included, the preparing step assumes a vital part in deciding the nature of the last items [6, 8]. Rheological conduct maybe considered the most imperative property of polymeric materials concerning their handling conduct. Thickness control amid preparing of thermosets is especially basic in light of the fact that the consistency shifts with temperature and stream conditions, as well as with time as a result of polymerization responses. The objective of the present study was to investigate the link between cuing agent content, temperature and rheologi indicate of the composite material.

Exprimental Work

The action of rheological the commercial (Epikote 828) epoxy and curing agent (1,4-Diaminobenzene) with 20 wt% of silica nanoparticle disperse in the epoxy was considered using Viscometer Model RV-II + Programmable rotational. Contemplated by hand for 15 min. The resulting mixture was more tried quickly. The viscosities of the resin system containing 12 to 21 wt% stoichiometry of hardener and exposed to isothermal operation at a range of temperatures 80 to 110 °C with various rotational speeds of 100, 10, 1, 0.1 and 0.01 rpm were recorded for every arrangement of test. The purpose of this change in speed was to protect the device from breakage. The viscometer is a completely laptop controlled gadget with a very much characterized menu framework. The yield information was seen on a screen in graphical and table from amid the measuring time. For isothermal estimations, the sample chamber was preheated to the sought temperature and balanced out at that temperature for five minutes.

3- Results and Discussion

3.1 Effect of on viscosity-time Curves

Fig. (1) to Fig.(3) shows the curing temperature and gel time effect of the viscosity in epoxy resin. It can be demonstrated that the curing rate increases with increasing temperature. The initial viscosity highly increases with temperature before commencement of curing. As the cure occurs, the viscosity curve blends traverse because of higher cure rate at higher temperature. When temperature increased, the slop also increased due to the higher rate of system. The distinction of the slop demonstrates that the temperature depends on the reaction.

These results are in agreement with that of Mounif et al. [9]. It can likewise be seen that every curve displays similar result, just moved by a steady component over the time axis. It takes after every one of the curves at various temperatures ought to be a similar form by just moving every curve towards the x axis with respect to a bend at a discretionary mention temperature with a shift factor [10].

Where phr is parts by wt per 100 parts resin.

3.2 inference of hardener content on viscosity-time Curves

Fig. (4) to Fig.(7) shows that the behavior of viscosity with 21 phr at 80 to 100 °C curing agent rises faster than that with 12 and 18 phr, which might be due to abundance of hardener. Also the results have shown that at 21 phr and 110 ºC, the rate of viscosity is decreasing, the reason might be that over the top hardener dilutes the resin which thus go impedes the cross linking response.

3-3 Effect of 1,4-diaminobenzene add on time

The time is considered as more important the essential limitations for different procedure. The gel time indicate effect of the temperature on the sample. Estimations are done at specific temperature. In this procedure, the effect of hardener content (12 to 21 phr wt %) in time for the sample at various temperature (80 to 110 °C) was investigated as shown in Figure (8) which demonstrates that the hardener content has slight influence in time at the temperature is higher 90 °C and curing agent sample surpasses 18 phr. Actually, the temperatures at less 110 °C and hardener substance is under 18 phr, increasing in gel time together the diminishing curing operator consist at a similar temp.; increases with the reducing hardener at same temperature; and shortens with increasing of same temperature at constant phr of hardener. Additionally, it appears that at 110 °C and when the hardener content is over 18 phr, increasing gel time with the increase hardener content at a similar temp..

4-Conclusion

In the present work, The temperature and content curing agent effect in the rheological was study for the epoxy resin .

Results showed that the gel time is effected slightly when the temperature was higher than 90 ºC and curing agent content surpassed 18 phr while at 110 °C and when curing agent content was over 18 phr, gel time increased at same time increasing hardener content at a similar temperature.

Acknowledgment:

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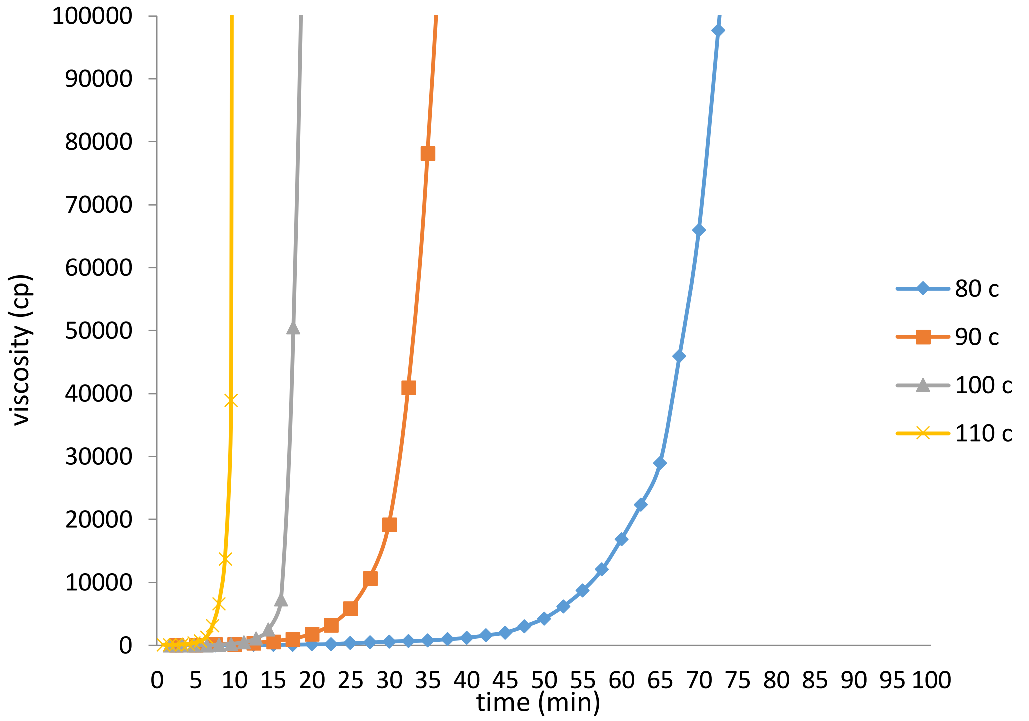

Figure 1. Viscosity versus gel time at different curing temperatures and 12.00 phr.

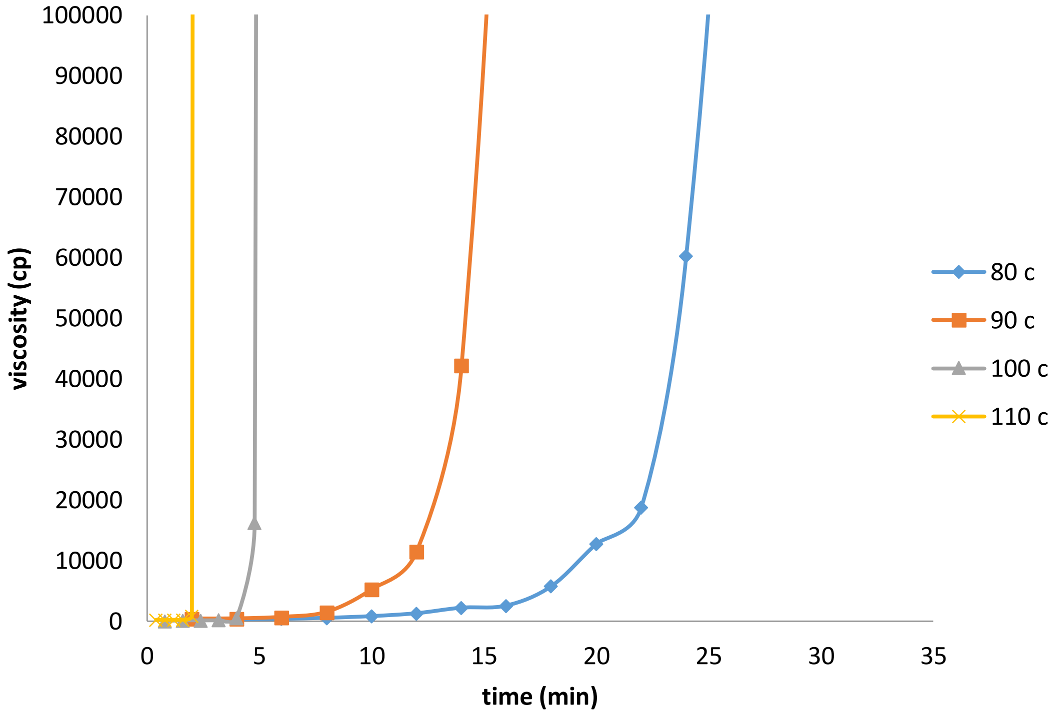

Figure 2. . Viscosity versus gel time at different temperatures and 18.00phr.

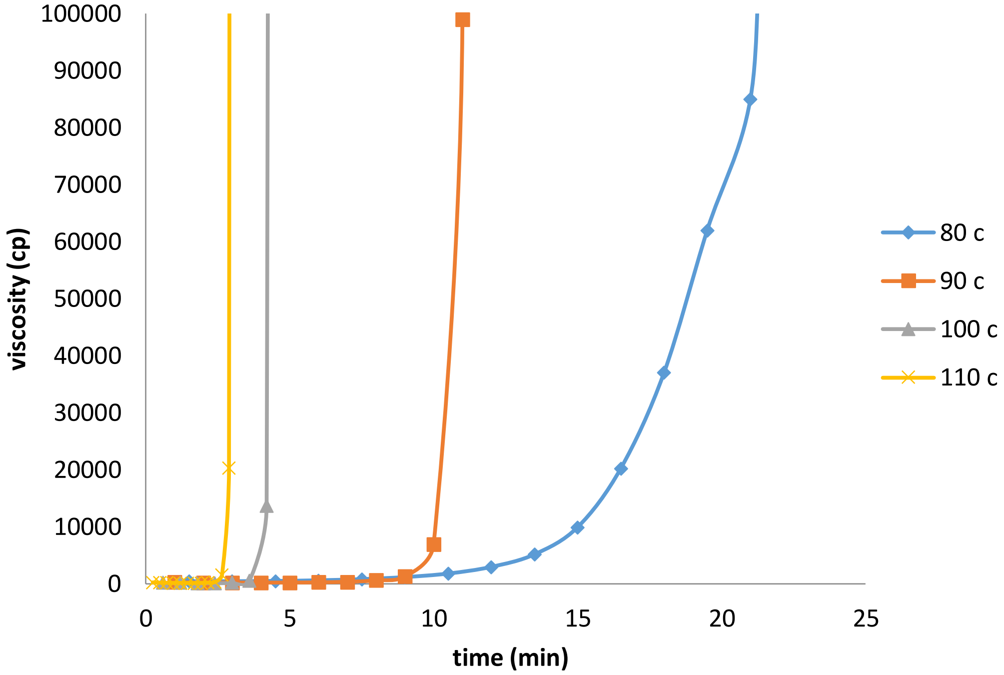

Figure 3. Viscosity versus time at different temperatures and 21.00phr.

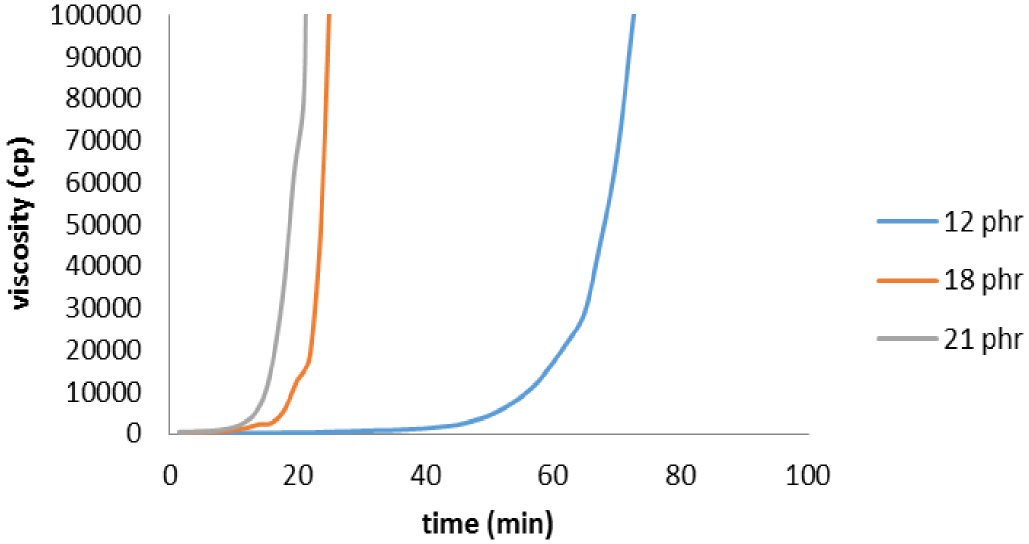

Figure 4. Viscosity vs gel time with differ cure composite at 80 °C.

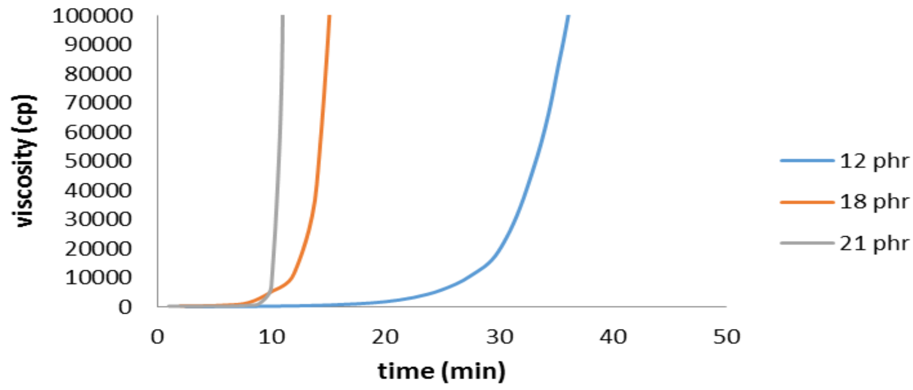

Figure 5. Viscosity vs gel time with differ cure composite at 90 °C.

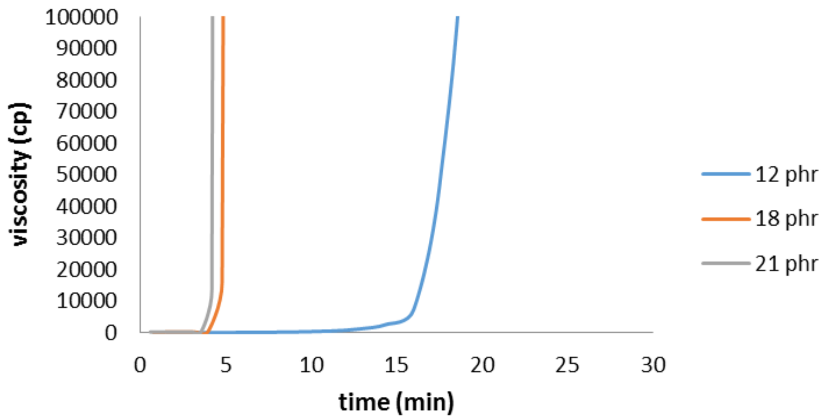

Figure 6. Viscosity vs gel time with differ cure composite at 100 °C.

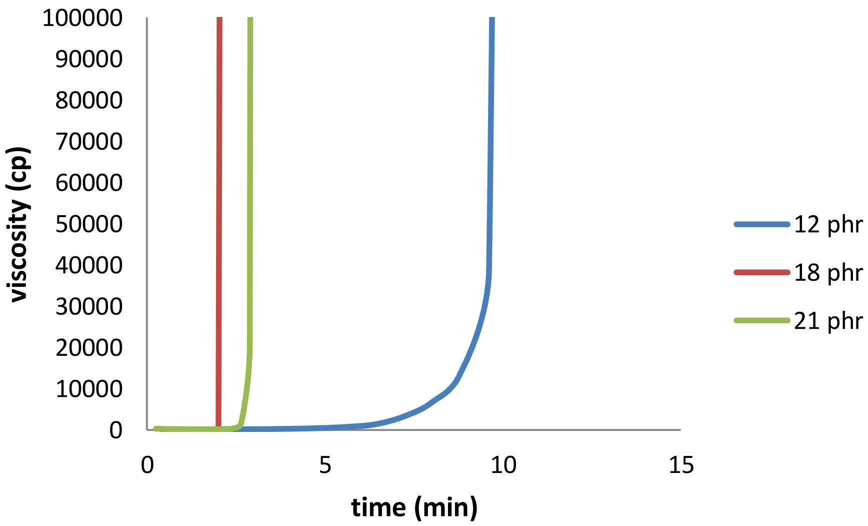

Figure 7. Viscosity vs time with vary hardener ratio at 110 °C.

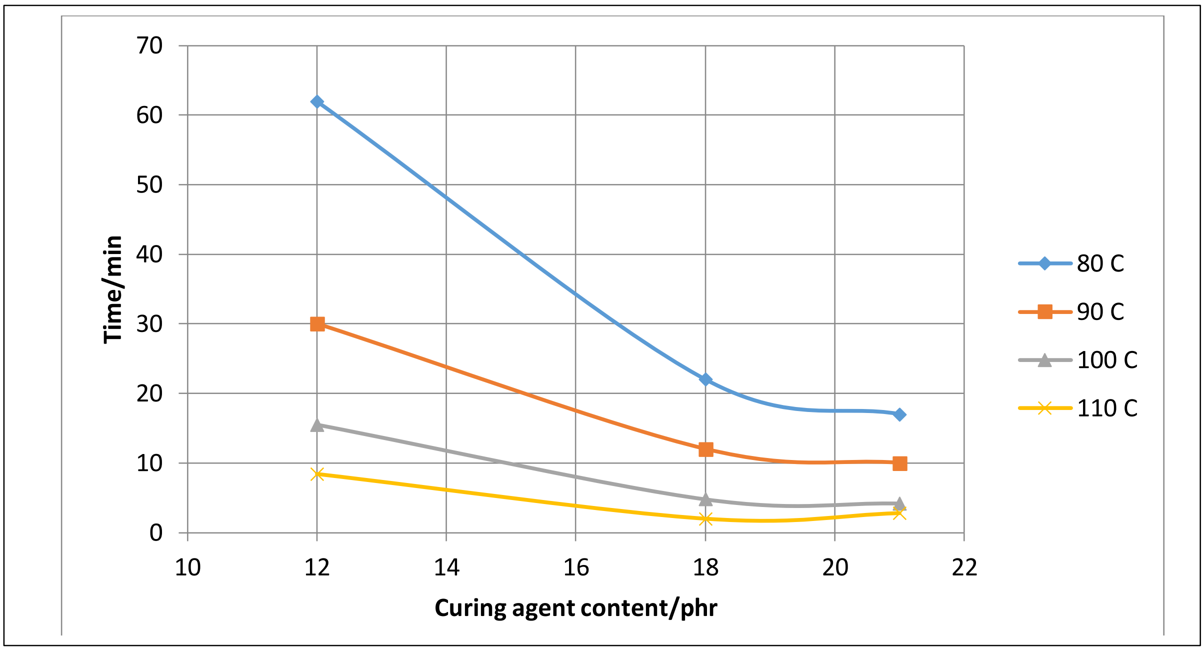

Figure 8. Curing agent content versus time at different temperature.