

## Green PU as Adhesive in Single Lap Bonded Joints

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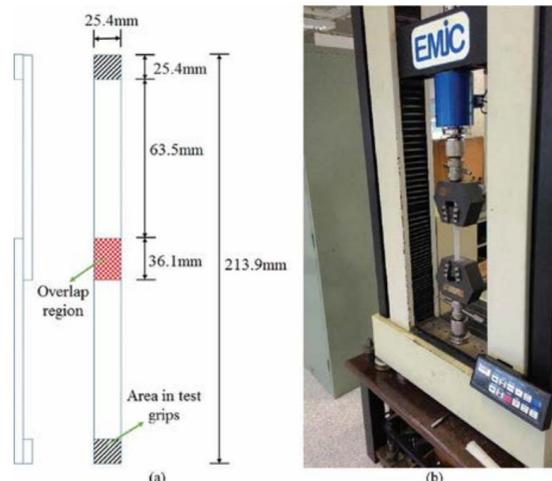
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The present work aims to compare experimental results of castor oil PU and epoxy resin not only as matrix of composite materials, but also as adhesive of bonded joints. The castor oil has enough hydroxyl groups to be used as polyol for the PU synthesis [1-3]. Regarding the studies about bonded joints, Li et al. [4] investigated that among the many types of these joints, the three most commonly used are: Single-lap, double-lap and scarf-lap joints. The joint coupons were manufactured by using castor oil PU-glass fiber and epoxy-glass fiber as adherents, which were bonded by epoxy or castor oil PU. Thus, four combinations of adherents and adhesives were investigated. Two different composite materials were studied in this work. The raw materials used in this work were: unidirectional glass fibers [WRU-140] with 140 gr/m<sup>2</sup> supplied by Texiglass™ (Vinhedo, Brazil); the epoxy araldite® resin by Maxepoxi™ (São Paulo, Brazil) which is composed by specific resin [1564 BR (85% m/m)] and hardener [REN HY 150 BR (15% m/m)]; and the castor oil polyurethane by Poliquil Araraquara Polímeros Químicos Ltda (Araraquara, Brazil) which consists on a pre-polymer [329L (59% m/m)] and a polyol [471 (41% m/m)].



**Figure 1** – (a) Geometry and dimensions of test coupons and (b) experimental setup.

The composites' manufacture process was resin infusion (RI). In this way, dry fibers were firstly laid-up over a flat glass mold, according to the required stacking sequence. To perform the comparison between both composites, it was carried out experimental analyses based on the ASTM D5868 [5]. The test scheme and specimen geometries are shown in Figure 1.

Table 1 summarizes the experimental and numerical maximum force results. The experiments show that the coupons with epoxy adhesive, for both layups, can support more load than the others with PU adhesive. For [0/90/0/90/0]<sub>s</sub> adherents, the epoxy adhesive supports higher loads than PU adhesive (about 6500 N vs. 5700 N). For [45/90/0/-45/45]<sub>s</sub> adherents, this difference was not so pronounced, but the joints with PU as composite matrix failed under lower loads compared to epoxy as composite matrix

**Table 1** – Experimental maximum force results.

Stacking Sequence	Composite Type	Experimental ultimate force [N]
[0/90/0/90/0] <sub>s</sub>	(PU matrix) + PU adhesive	5656 ± 196
	(PU matrix) + Epoxy adhesive	6563 ± 650
	(Epoxy matrix) + PU adhesive	5770 ± 652
	(Epoxy matrix) + Epoxy adhesive	6529 ± 343
[45/90/0/-45/45] <sub>s</sub>	(PU matrix) + PU adhesive	4922 ± 807
	(PU matrix) + Epoxy adhesive	4983 ± 340
	(Epoxy matrix) + PU adhesive	5295 ± 363
	(Epoxy matrix) + Epoxy adhesive	5738 ± 491

The experimental results showed that PU derived from castor oil has good mechanical performance, making this material a feasible alternative for bonded joints, mostly nowadays when environment is a major concern.

## REFERENCES

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