FABRICATION OF PANEL PRODUCTION FROM GYPSUM AND SAWDUST

F. W. ABDULRAHMAN, A. N. EBOATU & AND G. NWAKOR

Department Of Pure And Applied Chemistry, Usmanu Danfodiyo University, P.M.B 2346, Sokoto

ABSTRACT:

Sawdust has contributed a lot of fire hazards in the environment. These fires have destroyed many lives and properties worth millions of Naira. To prevent further destruction, this study reveals an investigation into the use of sawdust for panel board. A panel product was made by blending sawdust and gypsum. The pliable material obtained was differently bonded by means of three adhesives of cornstarch, gumarabic and polystyrene (PSt). The mechanical properties of the fabricated product were found to depend not only upon sawdust-gypsum concentration but also on the nature of the adhesive. Reasons are adduced to explain these observations.

INTRODUCTION

Though the use of waste-wood is as old as humankind, [1] the most important of these in large areas of the world still remain as fuel. Throughout the developing World, people consume fuel wood and charcoal faster than they can be renewed. This lads to rapid deforestation. Fortunately, changes in manufacturing technology, particularly, the development of plastics and light weight foams, have reduced the demand on wood-waste in building construction.

Fabricated wood products vary in their structures, weight, sizes, etc, and have inherent advantages over solid timber. They can be made into flat sheets, which do not 'work', 'wasp' or 'check' and can be worked and cut to sizes easily. The blending of gypsum and sawdust gives material with enhanced Acoustic and thermal insulation characteristics. Such products can be used for interior partitions, floor insulation, wallboards and roofing. In this article, we describe the mechanical properties of panel product made by mixing various proportions of sawdust and gypsum.

EXPERIMENTAL

Material:

i. Sawdust was obtained from local sawmill. The dry sample was ground to mesh size of 0.05mm sieve.

ii. Gypsum was procured from Wurno, a town near Sokoto. It was washed, dried and ground to 0.05mm mesh size. No further processing was carried out.

iii Adhesives used are cornstarch (Paste in Water), gum Arabic (in water) and polystyrene (dissolved in toluene).

Method:

Different blends of various ratios of sawdust, gypsum and adhesive were prepared and allowed to dry as a thin layer sandwiched between flat wooden plates. The following measurements were carried out on the panel products prepared:

i. Thickness was determined by means of the Vernier calipers while width was measured with ordinary ruler.

ii. For the measurement of stress and tear strength, the equipment shown in Figure 6 was improvised. The working of this equipment is self-explanatory. The initial reading on the ruler was taken as X. Loads were added to the pan until error first crack. At this point the final reading X_1 and the weight necessary to cause the crack load at break were noted. Extension at break was calculated as:

$$\frac{X_1 - XX}{L} \quad \frac{100}{1}$$

Where L is the original length of sample.

iii. Flexural rigidity was determined by means of the Leyhold-Heraeus instrument (portion shown in Figure 5), Model No. 34302, Br. I.

RESULTS AND DISCUSSION:

It is evident in Figure1 that irrespective of the nature of adhesive, in all cases increases in the quantity of sawdust significantly reduces the flexural rigidity of the panel product. However, in the case of pure gypsum product, the type of adhesive has a controlling influence on the flexibility of the sheet, being in the order: Polystyrene bonded > gum Arabic bonded us starch bonded. The function of the adhesive is to bind the particles of sawdust and gypsum. The degree of binding and hence, the force of attraction will depend not only on the particles but perhaps more on the adhesive type. Binding is a physical – chemical phenomenon which is determined among other things, by the molar mass of the binder, presence or absence of dispersion forces, H-bonding, as well as lock-and-key mechanism[2]. All that can be said at this stage of this work is that whatever is the major contributor here is manifested most in the polystyrene bonded sample.

A remarkable observation in Figure 2 is that the product with PSt as a binder is the most easily stretched of the three. Deformation involves slippage of materials past one another, i.e., when a sample is subjected to a stretching force, the resultant response, extension, etc, is generally the sum total of three separate components:

i. The elastic deformation which is time – independent and is instantaneously recovered on releasing the load,

ii. The secondary creep comprising a time – dependent viscous flow and elastic deformation, though the recovery is rather slow when the load is removed,

iii. The permanent creep is time – dependent, but there is no recovery on withdrawal of tension.

From the observation show in Figure 2, it is plausible to suggest that PSt does not hold the sawdust and gypsum materials as strongly as the two polysaccharides. This is possibly due to lack of H-bonding sites in this synthetic polymer. H-bonds with molecules of sawdust would have led to more rigid three-dimensional structure that is not easily stretched. The fact that the extensibility of the panel boned with gum Arabic and starch are about equal is attributable to the very similar molecular structure of these substances.

The resistance by materials to rupture/tear when subjected to various stresses is of great technological importance. Tear develops in materials by either the mechanism craze formation or shear banding. It can be seen, Figure 3, that whereas the PSt – and gum Arabic bonded samples have bout equal resistance to tear at all concentrations, the material made with starch as component, shows rather low resistance. This is difficult to explain. All that is evident at present s that as in the case of stress Figure 2, the trend shows a maximum at about 30% sawdust concentration. Again why this concentration is optimal s not easily discernible by present investigation.

The picture presented in Figure 4, for Young's Modulus is rather complicated, nonetheless it is observed that there is still a striking similarity in behaviour between the gum Arabic and starch – bonded samples, due as has been stated earlier, to the nature of the two macromolecules. The case of the PSt bonded materials is a bit anomalous in behaviour.

CONCLUSION

From the work reported in this article a few conclusions are thus:

i. It is possible to prepare panel boards by mixing finely ground sawdust and gypsum. It is not necessary to select a particular plant species. It is also evident that locally obtained gypsum does not need special mineralogical treatment, but used as received from the field.

ii. An attempt to simply bond the two components together by compaction with small forces, and at ambient conditions could only yield a pliable material.

iii. It is concluded that to obtained a fairly strongly bonded material at room temperature, one needs the incorporation of organic adhesive such as cornstarch, gum Arabic and polystyrene.

iv. An interesting aspect of this work is that it is the adhesive type that determines the physical and mechanical properties of flexural rigidity, extensibility, tears strength, load – at – break as well as Modulus.

v. It may also be concluded that where adhesives have similar chemical structures, i.e gumarabic and starch, the mechanical profiles of the panel board formed with them as binders, are similar.

REFERENCES

1. Jon Vogler, (1986); Volunteers for Technical Assistance; Understanding Non-fuel uses of Wood waste & Virgnia, USA, pp 1-3

2. Allen K. W., (1978); Adhesion; Applied Science Publisher Ltd., Vol. 2, pp 21.