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**SURVEY OF PLYWOOD AND  
PAPERBOARD FACTORIES**

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## **ABSTRACT**

Adhesives play very important role in the production of plywood. However the components and their ratios in an adhesive mixtures, do affect the properties of the plywood manufactured. As such a survey of some of the plywood mills in Brong Ahafo, Kumasi and Takoradi was conducted to ascertain their operating conditions.

The mills visited showed very similar operating viscosity (55-60) except one mill where their viscosity was 70secs. While one mill imports P/F resin for their export markets, all the others operate with U/F resin. The U/F resins imported are of different brands, but the operating conditions are the same.

Two mills are consistent in the type of resin that they use, while one mill utilises three different brands of U/F resin.

## **LIST OF ABBREVIATIONS**

M/F Melamine / Formaldehyde

P/F Phenol/Formaldehyde

U/F Urea/Formaldehyde

OYCL Oti Yeboah Complex Limited

ABTS Asuo Bomosada Timbers and Sawmill Limited

LLL Logs and Lumber Limited

NDVP Naja David Veneer and Plywood

WVLC Western Veneer and Lumber Company

## INTRODUCTION

Solid wood as a structural material has a number of advantages and disadvantages over other structural materials. Some of the principal disadvantages of solid wood as structural material are its heterogeneity, anisotropy, variability and its absorptive capacity for water and vapours. It is possible to overcome some of these disadvantages by cross banding to a large extent. These improvements, of course, are not adequate for special purposes. Plywood and particleboard are products of such re-constituted wood material, which play important part in the life of mankind. In order to manufacture these products, the veneer or the chips need to be bonded to each other. The bonding material is what is called adhesive.

Adhesives could be grouped into two main types; Natural (starch, dextrans and vegetable gums and protein glues) and Synthetic (thermosetting and thermoplastic resins). The two types of adhesives have their advantages and disadvantages. The natural glues form very good bonds and are in most cases expensive, not waterproof and are attacked by micro-organisms. Thus in most of the plywood mills, synthetic resins are used.

Because of the expensive nature of these adhesives, certain materials are often added to reduce the cost of adhesive and also impart special effects on the mixture. These materials are called additives and are classified as fortifiers, extenders and fillers. These materials are inexpensive and therefore are used to cut down the high cost of these synthetic resins. Depending on the nature of these additives, the resin and the nature of the wood species the additive normally make up about 14% of the total cost of the adhesive mixture. But all things put together the cost component of these adhesives is paramount to manufacture of composite materials.

Imports of adhesives into Ghana are shown in Table 1. The table reveals that there was a gradual decline of imports from 1995 to 1997 and thereafter an increase in 1998 and a decrease in 1999 to 1995 levels. However the Table shows that the CIF value has been increasing from 1995 to 1999, and in 1999, where the weight imported is the same as in 1995, the CIF value was about 5.5 times the 1995 value.

**Table 1. Imports of Adhesives into Ghana 1995-1999.**

<b>Year</b>	<b>CIF value (¢)</b>	<b>Net Weight (Kg)</b>
1995	1,518,439,257	3,409,012
1996	2,387,892,180	2,183,560
1997	2,957,874,421	1,718,032
1998	8,283,473,342	5,882,054
1999	8,424,921,051	3,300,278

*Source: Ghana Statistical Services.*

The cost of adhesive therefore becomes the cost determinant for the production of plywood. For plywood production, the cost ratio of adhesive to wood is about 25% of the finished panel (Rajak, 1973). The figures in the local industries are rather high. According to Quayson (1997) for P/F resins, the percentage adhesive cost in local production increased from 51.7 in 1992 to 60.7 in 1994, while for U/F resin, the percentage adhesive cost actually reduced from 48.5 in 1992 to 42.9 in 1994. These figures are very high for the plywood industries. For not only are substantial capital needed to run the production lines but much more is needed to stockpile against shipping delays. The P/F is more expensive than the Urea/Formaldehyde. The External Trade Statistics indicate that there were no imports of P/F in 1995 and 1996. The amounts imported in 1997, 1998 and 1999 were 600, 3.0 and 340Kg respectively. This shows that the P/F resins are of limited usage in Ghana, though the P/F resins produce bonds of high quality and good for exterior works. This high cost has forced most plywood mills to use U/F resins and therefore the products have found limited export market, except to a few neighbouring countries and for local consumption. All of these suggest that something should be done to decrease the adhesive cost ratio in plywood production.

The weight and CIF value of some adhesives are shown in Table 2. The types shown are natural adhesive except cassava-based adhesive and the synthetic adhesive represented by the three most used adhesives: P/F, U/F and M/F. The table also shows that, there was a decline of imports from 1998 to 1999 for most of these adhesives except for cassava-based adhesives, where there was a moderate increase. But the CIF value showed an increase for the three types under discussion. Showing that with the same amount of money in 1999, the mills actually imported less of adhesives.

**Table 2: Imports of selective adhesives into Ghana for 1998 and 1999**

Year	Natural Adhesive		Synthetic Adhesive		Cassava Based Adhesive	
	Net Wt. (Kg)	CIF value ¢	Net Wt. (Kg)	CIF value ¢	Net Wt. (Kg)	CIF value ¢
1998	2,281,447	3,156,848,968	4,170,845	3,088,829,451	481,789	1,532,634,845
1999	1,846,480	3,739,334,310	1,453,799	1,781,016,430	509,516	1,851,419,217

*Source: Ghana Statistical Service.*

The consequence of this is that the production level of plywood in the mills is reduced. Table 3 shows that the natural adhesives are more expensive than the synthetic resins.

**Table 3: Percentage Increment of CIF value per Kg of Adhesive for 1998 and 1999.**

Year	Natural Adhesive	Synthetic Adhesive	Cassava-Based Adhesive
1998	1383	741	3181
1999	2025	1225	3634
% Increment	31.7	39.5	12.5

And more importantly cassava-based adhesives are shown to be more expensive than the other natural adhesives on kilogram basis. In fact the cassava-based adhesives are about 3(three) times and 4(four) times more expensive than the other natural resins and synthetic resins respectively.

The cassava could be used both as fillers in adhesive mixture for the plywood manufacture or as the sole binding agent in the paperboard mills. Thus if it is used as filler, the amount of adhesive in the mixture could be reduced because of the adhesion nature of the cassava flour. This could help in reducing the cost ratio of adhesive in plywood production.

In order to understand the needs of the plywood and paperboard mills, it became necessary to undertake a survey of some of the mills. This was to learn about the type of raw materials they are using, the ratios of the mixtures and their operating parameters. These were to be used as a guide in our formulation studies.

## Work Done

Three trips were undertaken during the period of the survey

- a. To Brong Ahafo Region to visit two plywood mills, OYCI and ABTS
- b. To Kumasi area to visit two plywood mills, LLL and NDVP and
- c. To Takoradi to visit two plywood mills, WVLC and Prime Woods and two paperboard mills, PCC and Multiwall factories.

During these visits, interviews were conducted with the General and Production Managers on the operating conditions of their mills. Such conditions as: temperature, time and pressure of pressing, the type of resin and the adhesive mixture being used.

## Results and Discussions

The survey on the plywood mills revealed that on the average, Ghana imported about 3,300,000kg of adhesives, worth about 8 billion cedis (CIF) in 1999. And the percentage wheat flour in the adhesive mixture is between 45-66 by weight, the lowest at NDVP (Ashanti) and the highest at Prime Wood (Western). Table 4 shows typical operating conditions in the mills.

**Table 4: Adhesive Mixture being used for Plywood Production for Local Markets**

COMPANY	U/F (Kg)	Wheat flour (kg)	Water (kg)	Harder (kg)	Preservative (kg)	Viscosity (Seconds)
LLL (Kumasi)	50	30	80	1.5	0.6	50-60
NDVP (Kumasi)	100	45	129	5	-	70-75
OTI (B.A.)	160	80	40	8	3	50-60
ABTS (B.A.)	160	80	40	8	3.2	50-60
WVLC (Takoradi)	25	25*	60	1	0.25	50-55
Prime Wood (Takoradi)	45	30	40	1	-	50-55

\*Made up of 15kg wheat and 10kg of cassava flour.

Table 4 shows that the viscosities of the adhesive mixtures are fairly constant except for that of NDVP (Kumasi), which was higher than the rest. The two mills in Brong Ahafo region appear to operate with the same conditions, which are different from the mills of the other regions. It should be mentioned that

WVLC from Takoradi was using as extender, a mixture of wheat flour and cassava flour. The percentage solids also changed from as low as 45 at WVLC to as high as 85 for the two mills in Brong Ahafo. These wide variations are also shown in Table 5, which shows the brands of adhesives imported into the country.

Table 5 shows a wide range of brands of adhesives that are imported into the country. The only mill importing P/F resin is NDVP of Kumasi. All the others import U/F resin, but their brands are so varied except for Cascanite 501, which is being used by three of the mills LLL, ABTS and OYCL. Two mills: LLL and ABTS use only one type of resin, while the other mills do use more than one brand of U/F resin.

It can also be seen that the viscosities are as varied as the brands of resins. These range from as low as 30secs at OYCL using Sodorite 505 to as high as 125secs also at OYCL but using Cascanite 501.

Table 5: Composition of Adhesive mixture and their Viscosities in some of the Major Plywood Industries in Ghana.

Name Of Company	Type Of Resin	Resin (Kg)	Hardener (kg)	Extender (Kg)	Preservative (Kg)	Water	Filler	Viscosity (secs)
LLL	U/F Cascanite 501	50	2.15	30	1.5	80	-	45-60
NDVP	U/F Aerolite FFD	100	7.5	50	2	190	30	55-65
NDVP	U/F Kaurit	100	7	40	-	125	10	55-65
NDVP	P/F Dynosols-576	100	60	15	-	110	-	60-65
ABTS	U/F Cascanite 501	100	1	50	2	150	-	45-60
OYCL	U/F Cascanite 501	100	8	50	3	50	-	100-150
OYCL	U/F U/F Aerolite FFD	50	1.5	15	1.5	45	-	35-40
OYCL	U/F Sodorite 505	160	8	50	3	80	-	23-30



## CONCLUSIONS

It could be concluded from this survey that the plywood mills are operating under very similar conditions. Most of the mills are operating with U/F resin except one mill that utilises P/F for its export markets.

That the mills are importing different brands of U/F resin with one mill utilising three (3) different U/F resins. As a result, the operating viscosities are also varied ranging from as low as 30secs to as high as 150secs. These two extremes are being operated by one mill. As such, it was decided to use Cascanite resin from LLL and operate at a viscosity of 45-60secs.

## References

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