

Overview of the Wood Adhesives Industry in China

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Abstract

Adhesives products and demand for them in China are discussed in this paper with special emphasis on wood adhesives products in this decade.

In 1994, the wood industries in China consumed more than 330,000 tons of adhesives. The estimated demand for wood adhesives will be more than 560,000 tons in the year 2000. The main wood adhesive used is urea-formaldehyde resin. Its consumption in 1994, was approximately 90 percent of the total wood adhesives market. The production capacity of formaldehyde will continue to be the main factor affecting the growth of the wood adhesives industry

Introduction

China's economy continues to grow at a fast clip, expanding 9.5 percent in 1996. As a result, both residential and commercial construction continue to boom, predominantly in urban areas. Demand for wood for building and construction, as well as furniture and paper products, is growing. Composite panel production reached 6.6 million m³ in 1994, and is estimated to grow to 9.5 million m³ in 2000 and 13.5 million m³ in 2010. Consequently, the demand for wood adhesives is also growing. This paper presents an overview of the most recent developments of the adhesive industry in China.

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Adhesives consumption

Most panel production plants have in-house resin manufacturing facilities to produce resin adhesives for their own use, which are considered as an integrated part of plant operation. There is no organization that collects wood adhesives production data for the nation. The few published data on resin consumption are mostly derived from computations based on panel production. Table 1 shows one such tabulation based on recently published data on wood adhesives (15).

In 1994, approximately 90 percent of wood-based panels were bonded with urea-formaldehyde (UF) adhesives. Production trends in this segment of industry suggest UF resin consumption

Tab& I.-Estimated wood adhesives consumption in China.

| | 1994 | | 2000 | | 2010 | |
|-------------------------|--------------|-------------|--------------|-------------|--------------|-------------|
| | UF | PF | UF | PF | UF | PF |
| ----- (1,000 ton) ----- | | | | | | |
| Plywood | | | | | | |
| Interior | 126.3 | | 165.0 | | 215.0 | |
| Specialty | | 12.6 | | 20.0 | | 27.6 |
| Bamboo | | 4.4 | | 9.0 | | 12.0 |
| Particleboard | 131.2 | | 183.0 | | 304.0 | |
| Fiberboard | | | | | | |
| Hardboard | | 15.7 | | 13.5 | | 14.5 |
| MDF | 43.1 | | 216.0 | | 332.0 | |
| Subtotal | <u>300.6</u> | <u>32.7</u> | <u>564.0</u> | <u>42.5</u> | <u>851.0</u> | <u>54.1</u> |
| Total | 333.3 | | 606.5 | | 905.1 | |

tion will grow more than 10 percent annually up to the year 20 10. The projected quantity of UF adhesives consumption in 20 10, however, is subject to some question. In view of the most recent rapid expansion of the medium density fiberboard (MDF) and hardwood plywood production capacity (Table 2) it is highly possible that the demands for UF adhesives in 20 10 will be higher than the projected quantity of 85 1,000 tons.

Development of the bamboo plywood industry in recent years greatly increased the use of phenol-formaldehyde (PF) adhesives. Uses of structural plywood in such applications as truck beds, railroad boxcars, concrete forms, and shipping containers increased from 120,000 m³ in 1994 to 240,000 m³ in 1996 (14,16). It is expected that the consumption of PF adhesives will increased substantially if the outcome of the development of OSB, which is in the very early stage of development in China, is commercially successful (13).

The major factor that may affect the future development of the adhesive industry in China is the extremely tight demand and supply situation of formaldehyde. The planned construction of formaldehyde production facilities **was not** considered a high priority project by the government in past years (2,12). However, with the market-oriented economic policy in place, new formaldehyde production capacity has been added to support the current needs of the expanding panel industry (22). The substantial increase in production capacity of ammonia and urea for agriculture (which has been the highest priority in China's needs for years) has greatly improved the available supply of urea.

Since 1994 the general economic expansion in China has also increased business opportunities in the adhesive industry for foreign companies. A major Northern European adhesive company has sold several resin production control devices to China and is actively negotiating a joint venture for the establishment of a centralized manufacturing complex for production of **wood** adhesives (1,10). Such a centralized adhesive production facility is expected to bring to China needed advanced resin technology, reduce production costs, and enhance environmental protection by improving chemical storage, transportation, and safety (10). More recently, it was announced that a major isocyanate

producer from the West is also negotiating a joint effort on a \$400 million investment plan to produce isocyanate resins in Shanghai (8).

Binder qualities

In 1990, the Chinese government established the National Center for Supervision and Testing of Quality of Wood-Based Panels (NCSTQ) to oversee the certification of product acceptance, Product acceptance is based on the test evaluation of panel products according to the established properties criteria in the national standard. In 1995, NCSTQ sampled 22 MDF plants and 41 particleboard plants nationwide; and again sampled 32 MDF plants in 1997 for quality acceptance. The overall products acceptance ratios were 50 percent for MDF and **37** percent for particleboard in 199 5, and 63 percent for MDF in 1997. Significant improvement in the acceptance ratio of MDF had been made from 1995 to 1997. It should be noted, however, that the extremely low acceptance ratio (37%) for particleboard was far below acceptable level. The quality problems existing in China's particleboard industry have been recognized for years. Although **some** new modern particleboard production facilities have been constructed, the majority of the particleboard plants in China are still inefficient, old, small plants.

Table 3 summarizes the results of some of the property acceptance evaluations in 1995 and 1997 (6,7). It should be mentioned that only those properties that are in some way related to binders are included in Table 3. The values in the table denote the percentage of the samples that met the acceptance criteria.

The results shown in Table 3 clearly indicate that low quality acceptance ratio of formaldehyde emissions (i.e., high formaldehyde emission) is the

Table 2.—Plywood and MDF production capacity from 1992 to 1997.

| Year | Plywood | MDF |
|------|-------------------------------------|-------|
| | (1,000 m ³) | |
| 1992 | 700 | 313 |
| 1993 | 1,700 | 498 |
| 1994 | 2,600 | 702 |
| 1995 | 7,600 | 918 |
| 1996 | | 1,890 |

major concern of binder quality, particularly if one notes that the acceptance level of formaldehyde emission in China (70 mg/100 g) is more than twice that in the United States (30 mg/100 g). In responding to this important formaldehyde emission problem, vigorous research efforts focusing on lowering formaldehyde emission have been made. Some of the significant research achievements were summarized in a recent report (11). Furthermore, improvements in formaldehyde emission of MDF were shown by the substantial increase in the acceptance ratio of 1997 (75%) as compared to that of 1995 (43%).

The 12 to 14 percent resin used in many of particleboard plants in China is high by world standards. This level apparently is needed to overcome other production problems in raw material preparation, drying, and pressing. As each step of the process is brought under control, less resin should be required. Therefore, the opportunity exists for further reduction in formaldehyde emission through better management, improved resins, and better process control.

Adhesives" from renewable resources

Because of the high cost of raw materials and the relatively inefficient production facilities, the phenol produced in China will always be expensive compared to that produced in the United States. A search for alternative resins made from renewable sources that may be available at competitive costs has always been considered a high priority area for future development. Several researchers have been actively involved in research and development of resins that are partially produced from spent sulfite liquor (7), Chinese wattle tannin (9,17-2 I), and other agricultural residues

(3,4). It is noted that among these alternative resins systems, the application of polyphenolic compounds from peanut hulls and Chinese wattle tannin in PF resin formulations holds great potential for commercialization in China. To increase the production of Chinese wattle tannin, the government has been vigorously promoting acacia plantations.

Conclusions

Urea formaldehyde adhesives, used in the production of approximately 90 percent of wood-based panels, is the most important binder for the wood industry in China. Although, the production capacity of formaldehyde hindered the growth of the wood adhesives industry, it is expected the production of UF adhesives will grow more than 10 percent annually up to the year 2010.

Formaldehyde emission from the panel products continues to be a major concern of the industry. Significant achievement in reducing formaldehyde emissions has been made through advancing resin technology and reducing UF adhesive application rates.

Development of the bamboo plywood industry greatly increased the uses of PF adhesives. The outcome of an OSB industry in China will largely determine the future growth of PF adhesives.

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Table 3.-Property acceptance ratio of MDF and particleboard in China.

| Property | MDF | | Particleboard |
|------------------------|-----------------|------|---------------|
| | 1995 | 1997 | 1995 |
| | (%) | | |
| Density variation | 17 | 97 | 98 |
| Formaldehyde emission | 43 | 75 | 78 |
| Thickness swell | 86 | 94 | 81 |
| Nail withdrawal | 86 | 91 | -- |
| Internal bond strength | .. | .. | 85 |

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