CHAPTER SEVEN

RESEARCH AND DEVELOPMENT

THE IMPORTANCE OF RESEARCH IN PLYWOOD

The plywood industry in India, as mentioned earlier is comparatively a new thing. For any new enterprise its self analysis is of optimum value. For the plywood industry also such an analysis is quite natural and therefore, the importance of research and development projects hardly need to be emphasised. The growth and expansion of the plywood industry throughout the country gave birth to specialised field research, applied research and systematic analysis of optimum utilisation of its products. The initial problem, so far as the plywood industry is concerned was, however, the dearth of raw materials (both timber and chemicals). The need of sophisticated ply items and their use in marine and aircraft required careful analysis. Moreover, there grew a heavy demand for export. The importance of Research and Development in this industry began only during the post war years. As evident from the IPIRI Journal: "With the general spurt in R & D activities during the post-war years there came the realisation that if the industry is to become self-reliant and diversify into
more sophisticated and specialised fields and attain international competitiveness for export, active efforts in basic and applied research in the fields of wood science and technology related to panel products would have to begun sooner or later."

A timely suggestion came from the Tariff Board in 1947 that the Plywood Industry should establish a research laboratory of its own. The Board recommended that a cess should be levied on plywood manufactured in the country and the proceeds devoted to research. The Board also stressed the importance of training technical personnel.

INSTITUTES AND FIELD STATIONS

The Government of India immediately picked-up the suggestions of the Tariff Board and set-up the Plywood Industry Voluntary Contribution Committee (PIVCC) to solicit funds to establish a Research Institute. With the availability of funds, in 1961 the Indian Plywood Manufacturer's Association was formed and it was assisted by the Ministry of Industry and Supply as well as by the Council of Scientific and Industrial Research (CSIR), New Delhi. This Association after formal registration (1961) gave birth to the Indian Plywood Industries Research Institute in Bangalore. "A nucleus of the
laboratory was set-up and work started. Similarly a temporary field station was established at Calcutta where land was purchased to put up permanent accommodation for the field station. The Plywood Manufacturers Association of India, Calcutta, donated the equipment and library of its Testing and Research Laboratory to the field station.

The Laboratory in Bangalore was moved into the new site of the Institute on 25th February, 1966. The present building of the Institute in Bangalore have a floor area of 3800 sq.m. The field station in Calcutta occupied its permanent building in April 1967. It has a floor area of 1074 sq.m. A second field station was established in Tinsukia, Assam, in 1970 in rented premises.

The choice of Bangalore for setting up the Institute has been most fortunate. Bangalore has excellent infrastructure facilities for R & D work. The Indian Institute of Science and the University of Agricultural Sciences complement each other in their interaction with wood science and technology. Bangalore also is the seat of an academic university². The Bangalore Institute since its establishment has sought and received cooperation
from the ICAR, the Dehra Dun Forest Research Centre, the
Forest Research Centre at Barnihat (Meghalaya) and the
various Agriculture Universities. The Institute is mana­
ged by a Board of Governors in collaboration with the
representatives of the industry, the CSIR and the offi­
cials of the Government of India and the respective state
Governments. For its finance the Institute has to depend
upon the industry and CSIR. The Institute has at present
a strength of 150 personnel including 36 scientists and
engineers. The Institute is equipped to carry-out R & D
work on a wide range of subjects.

AIMS AND OBJECTS

The aims and objectives of the R & D pro­
grammes, as far as the plywood industry is concerned,
are three fold. They are -

(1) To formulate and carry-out a continuing
cost and time bound result-oriented programme of research
and development work for the plywood, particle board,
hard board and allied industries

(2) To render technical services including
implementation of research and development results in
factories and

(3) To serve as an information, training and
testing centre for the industry.
To attain these aims and objects, the IP and other research agencies have worked a lot and have been able to contribute significantly towards reduction in cost of production, improvement of quality, optimum utilisation of timber resource and utilisation of panel products for engineering and similar applications.

R & D PROGRAMME OF THIS INSTITUTE

"The programme of R & D work of the Institute is formulated in consultation with the Industry. The Institute receives a continuous feedback from the industry based on production trials of the Institute's processes. The problems and projects taken-up by the Institute, therefore, remain practical and result-oriented and while serving the interests of the industry, often have a significant bearing on problems of national importance, for example mass housing and grain storage.

The R & D programme of the Institute drawn up by the scientists is finalised by the Scientific Committee and approved by the Board of Governors. The progress of work is frequently monitored by the Scientific Committee.

The science and technology of wood based panels are multi-disciplinary in nature. Each research and development project is handled by a team of scientists
specially formed for that project and drawn from the necessary disciplines".

FUNDAMENTAL STUDIES

"Almost the entire R & D work in the Institute in recent years is of an applied nature. Small items of work of fundamental nature which have been carried out relate to studies on the rheology of wood, and the wetting, penetration and flow of liquid adhesives into wood. In the study of the rheology of wood, some basic aspects of the rheology of the wood cell, wall thermodynamics of the deformation of wood under varying moisture contents, stress relaxation in wood and dimensional stability of wood based panels under differential humidity conditions, have been investigated. With respect to the study of adhesive-wood systems, the problems investigated are the determination of adhesion-tension of liquids, rheology of the flow of adhesives through thin capillaries, and the determination of the co-efficient of dynamic spread wetting of liquid adhesives on wood".

EXTENSION, INFORMATION AND TRAINING

"The period 1970-76 was one of a technological revolution from most of the plywood industry in the country. Veneer log protection was introduced, peeling quality improved, wood wastage reduced, resin kettles commissioned,
resin manufacture started and improved, new vastly economical adhesive formulations adopted, modern technique of pre-pressing and modern process control instruments introduced, a large number of personnel given systematic training and a still larger number given ad-hoc training, calibration of testing equipment carried out frequently, and regular testing of plywood and raw materials started, all with the assistance of the Institute."

THE AVENUES OF RESEARCH

The R & D programme of the plywood industry covers mainly adhesives and raw materials.

(I) Adhesives: Adhesives play an important part in this industry and therefore, the research workers had taken seriously the adhesives formulation to suit different grades of plywood. The basic consideration, however, was formation of resins according to newer needs. Considerable work has been done on UF, PF and MF resins in the past few years. The industry has been profited by the calculations made by the researchers on the ratio of reactants, manufacturing conditions and other details. "An adhesive based on urea, formaldehyde and deoiled groundnut cake was specially developed for small-scale tea-chest plywood manufacturers. By making use of urea
and formalin without pre-condensation, the need for a resin plant is avoided and the cost is kept low. The other improvement in the adhesives were the use of coconut cell powder and resin adhesives for glued plywood. The slashing of phenol in the preparation of PF resin also become important.

**Tannin also comes to use:** In modern times the development of commercially exploitable tannin based adhesives are in use. Because dependence on synthetic resins is not always possible. The researchers in IPIRI had formulated a special kind of tannin based adhesive. "Tannin based adhesives were specially formulated from wattle (mimosa) bark extract. The adhesive formulations make use of formalin instead of formaldehyde which is not manufactured in India. The use of new catalyst brought down the press temperature below 130°C. A proteinous additive improved bond strength and reduced penetration. Tannin adhesives fortified with 15-25 percent PF resin are used for BWR and BWP grades of plywood.** The particular achievement in the field of adhesive was the formulation of a phenol-cardanol-formaldehyde resin adhesive to suit the particle boards of rice husk origin. The development of rice husk board, it may be mentioned here, is a step towards the develop-
ment of boards for tropical countries, since such boards are resistant to termites and decay.

Moreover, these adhesives were further supplemented by the extenders and fillers. "Gelatinized tamarind seed meal, deoiled sal seed meal, groundnut meal and gluten are some of the extenders for UF resin introduced in the industry by the Institute. These have replaced cereal and tapioca flour which are foodstuffs. Sal seed meal which is truly a waste material is used to extend UF resin for pre-pressing of plywood. Soyabean meal is another extender found suitable for UF resin adhesives. Thus we see that in the avenue of the adhesives the IPIRI and other agencies helped to formulation of new ideas and newer applicability of the already existing materials.

Protection of Materials: The IPIRI could see the necessity of protection of wood and wood based panel materials. The Institute made mycological and entomological investigations aiming at the protection of wood and wood based panel materials. It was discovered that upto 30% of the timber was sometimes lost during transit and storage due to physical and biological deterioration. Prophylactic treatments developed in the Institute based on readily available industrial by-products are being used by the industry in different parts of the country to protect
veneer logs both decorative and commercial. Prior to this the loss during storage was very great.

**Development of Instruments**: The Institute had designed quality control instruments to help efficiency and better product quality. The four remarkable achievements in instrument technology for plywood are as follows —

(a) **Moisture Meter** to measure moisture content from 5 to 60%,

(b) **Moisture Scanner** for scanning the moisture content of veneers,

(c) **Temperature indicator** with a suitable probe to facilitate the measurement of temperature at any point on the surface of hot press platens, and

(d) **Veneer lathe adjusting** instruments.

It is interesting to note that IPIRI itself fabricates and supplies some of these instruments according to the needs of the industry.

**Research into mass housing needs**: In India, the main obstacle to the construction of rural and low-cost houses in very large numbers in the absence of a suitable roofing material. The researchers have developed a rice-husk
board roofing material on an experimental basis. The Institute has developed roofs made of preservative treated wood veneers. A veneer roof, treated, costs only Rs. 100 per M² for a rural type house. The veneer roof shingles are expected to give a life potency of 20 serviceable years. It is interesting to note that the veneer houses constructed in Bangalore slums have received well acceptance. The Institute has also developed techniques in design fabrication and erection of glued plywood pre-frabricated houses and systems. The researches have proved that it is possible to construct all plywood houses having pre-frabricated roof and wall units which can be provided with modern amenities and elegant finish.

Mini-structures and Furniture: The modern world has given rise to booths, stalls, counters and kiosks and the plywood industry has developed designs and success fully brought into market all plywood, portable, demountable and fully pre-fabricated portable shelters. These cabin type erections have the advantage even in adverse conditions and difficult terrains, if necessary.

Another important need of the modern societies is furniture. To meet the needs the Institute has developed low-cost all plywood furniture. Utility furniture like cots, tables, sofas etc. have now been designed and
displayed. These furniture can be easily mass produced and scrap plywood can also be used in manufacture of these furniture. Such sort of furniture nicely matches with the taste and purse of the people.

**Structural grade plywood and storage bins**: A new grade of plywood namely structural plywood for construction purposes has been developed. Structural plywood treated with preservatives, to resist decay termites and various other insects, is used for construction work. Water proof and weather proof structural adhesives developed at the Institute are extensively used for the assembly of wood-plywood building components.

Scientific storage system for food grains have been developed and grain storage bins of various shape and sizes have been developed. The Institute has designed grain storage bins of capacities ranging from one quintal to 60 tonnes from plywood to meet a variety of end use requirements, such as small, medium and relatively large capacities, indoor and outdoor types, cylindrical and rectangular, pre-fabricated, knock-down and portable varieties, and for institute constructions. Several of these bins fabricated at the Institute have been evaluated by organisations throughout the country.

Functionally and structurally plywood bins are ideally suited for the domestic and rural sectors.
Cost wise, plywood bins offer the cheapest means of scientific storage of grain. The preservative-treated plywood, used for bins, is water proof, weather proof, decay resistant, insect proof, termite proof and resistant to rodents. Apart from these bins, storage tanks for chemicals and fertilisers designed and developed by the IPIRI personnels have been in advantageous use in different parts of the country. Provision for better door and window frames and shutters at a competitively lower price has been aimed by the Institute. Incidentally, it may be said that the small dimension woods, plywood and hard board make very fine frames and shutters which are durable and functionally adequate. Such techniques as developed by the plywood people eliminate the need for time-consuming carpentry works.

**Putty**: Putty is a great necessity for the plywood. The recent progress in research has formulated better putties to suit the needs of this industry. A hot melt type putty has been formulated from terpene resin binder, paraffin wax, china clay and pigments. When applied on a plywood surface and allowed to cool the putty fills the crevices and gaps on the surface and hardens in less than a minute, so that panels can be repaired very fast. Hot melt putty
is characterised by the absence of any solvent or condensation by product. With the progressive use of plywood the development of such kind of putty has become of optimum importance.

**Rationalisation**: With a view to simplify, improve and modernise the wood based panels all standard specifications are reviewed and rationalised. The rationalisation works comprise of standardising test procedures. Some items of this rationalisation are given below:

(a) Inclusion of a greater number of species of timber for the manufacture of marine plywood,

(b) Alternative test procedures for determining the glue shear strength of plywood, especially for multiply stock,

(c) Alternative test procedures for evaluating the internal bond strength of particle board,

(d) Alternative tests for evaluating the water resistance of tea-chest plywood,

(e) Test procedure for evaluating the surface strength of particle board,

(f) Method for determining the co-efficient of sustained loading of plywood,
(g) Test procedure for determining the limit of sustained loading for joints made with PVAc dispersion based adhesives, and

(h) Alternative methods for analysing the results of glue shear strength tests for conformity to requirements of standards.

SERVICES RENDERED SO FAR

The services rendered by the IPIRI and its allied agencies in the domain of research are praiseworthy. With the technical betterment, in the form of rationalisation and standardisation of all plywood materials have been continuously worked out. A good team of scientists well trained and well motivated and a number of engineers carry out the extension work in plywood factories and help the industry successfully to implement the processes, spearheaded at the Institute. It may be mentioned here that the IPIRI has not limited its functions to plywood materials alone. The Institute has collected information on the protection of thatch and bamboo traditionally used in rural housing in the country. Some experimental investigations have also been carried out on protection of thatch, bamboo and wood poles against decay insects, termites and weather. The Institute is guiding the interested parties in enhancing the service life of thatch-roofs, which generally have a low longevity.
RESPONSES

Responses from the millers, traders, exporters and other allied people towards the R & D work are very encouraging. It has been observed that, because of the close contacts between the industry and Institute, there is no communication gap between the technical personnel of the industry and the scientists of the Institute. All programmes of R & D are in active consultation with the industry. The Governmental departments, the ICAR and the Forest Research Institute at Dehra Dun are consulted whatever any need arises.

ASSAM AND R & D PROGRAMME

As mentioned earlier the IPIRI has opened a field station at Tinsukia, in Assam, to provide the various services to the plywood mills located in Assam. Uptill now 19 members of the Assam Plywood Manufacturers' Association have enrolled as members of the IPIRI. Though the Institute has provided various technical services to the plywood mills and majority of the plywood mills of the country is located in Assam, still enrollment to this Association is not adequate. The following table (Table 44) shows the association of the units with different organisation.
### Table 44

**STATEMENT SHOWING MEMBERSHIP OF THE ASSOCIATION**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Organisation</th>
<th>No. of units</th>
</tr>
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<tbody>
<tr>
<td>1.</td>
<td>All India Manufacturing Organisation (AIMO)</td>
<td>20</td>
</tr>
<tr>
<td>2.</td>
<td>Indian Standard Institute (ISI)</td>
<td>28</td>
</tr>
<tr>
<td>3.</td>
<td>Indian Plywood Industries Research Institute (IPIRI)</td>
<td>19</td>
</tr>
<tr>
<td>4.</td>
<td>All Assam Tea-chest Manufacturers' Association, Tinsukia, (AATM)</td>
<td>19</td>
</tr>
</tbody>
</table>

Source: DIRECT SOURCE

This poor representation from Assam is due to the lack of facilities in the field station. The field station in Tinsukia is not fully equipped with up-to-date instruments. The Employment Review Committee in their reports also observed similar views. The Committee suggests that the IPIRI should take necessary steps.

1. to build up the field station at Tinsukia in their own land,
2. to equip the station with men and machineries at par with Calcutta field station,
3. to conduct research for finding out alternative packing materials for tea-chest in place of tea-chest ply in view of scarcity of the valuable species.
On our visit to many mills of the Upper Assam Region, some of the mill authorities expressed their dissatisfaction with the activities of IPIRI's field station. The Ledo-Margherita Plywood Manufacturers' Association in an interview told us that the problems of the region are different from the other parts of country and therefore, a single field station cannot serve the entire needs of Assam. Therefore, there should be a fullfledged plywood research institute for the entire North Eastern Region with head quarters in Tinsukia. The main services offered by Tinsukia field station are as follows -

1. Demonstration of glue formation developed in the Institute laboratory,
2. Calibration of tensiometer,
3. On-the-spot study of the physical problems relating to plywood manufacture,
4. To respond enquiries received from different member factories,
5. Technology transfer regarding plywood manufacture,
6. Supply of auditing reading facility to the technical personnel in the laboratory,
7. Short-term training of workers and engineers,
8. Survey of the working of the different factories,
9. Testing of raw materials, plywood adhesives etc.

The services rendered by the Tinsukia field station to the different plywood mills of Assam in two years based on the above services are given below -

1981-82

87 visits to different member factories in connection with demonstration and discussion.
27 numbers of UF and PF resins adhesive tested.
14 numbers of formaline were tested.
27 numbers different grades of plywood were tested.

1980-81

13 visits were made to different units.
12 numbers formaline tested.
1 person was given training in plywood-process.

A team was also sent from Bangalore, named PPS team, to study the factory working and to suggest and advise regarding the work.
One FAO expert on adhesive paid a visit to the NE Region alone with scientists of the IPIRI.

One of the important function discharged by the Institute is training courses. Plywood is now considered an engineering industry. Training to the different category of persons is utmost urgent. But training given by the Institute to different categories of persons is very poor. We are furnishing below number of persons from the plywood industry in Assam who received training during the year 1975-78.

<table>
<thead>
<tr>
<th></th>
<th>1975-76</th>
<th>1976-77</th>
<th>1977-78</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Training (general product procedure)</td>
<td>4</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>(b) Plywood technology course (duration 3 months)</td>
<td>-</td>
<td>-</td>
<td>6</td>
</tr>
</tbody>
</table>

Considering the above, we can say that the service offered by the IPIRI through this field station is not adequate. The services must be up graded, modernised and well-equipped. In my visit to the Tinsukia Zone, I have realised that the field station is not properly equipped, with machines and other instruments.

The field station at Tinsukia runs with a very small and inadequate staff. In view of the size of the industry here, the present position of the
The Employment Review Committee on plywood industry in Assam, offered the following suggestions: The Chairman of the Indian Plywood Industries Research Institute, Bangalore (IPIRI) should take necessary steps

(I) to build up the field station at Tinsukia in their own land,
(2) to equip the station with men and machineries at par with Calcutta field station,
(3) to conduct research for finding out alternative packing materials for tea-chest in place of tea-chest ply in view of scarcity of these valuable species.

The Assam Plywood Manufacturers' Association, also felt that the existing field station at Tinsukia should be upgraded and be equipped with modern instruments. It may be considered here that Assam contributes a large subscription every year but the return given is meagre. We represent below a record of subscriptions, during the growth period 1975-78.
## Table 45
### YEARWISE SUBSCRIPTION FROM ASSAM

<table>
<thead>
<tr>
<th>Year</th>
<th>Subscription from members (in Rs.)</th>
<th>Area of subscription pertaining to the period prior to 18-6-70</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>4,35,651.13</td>
<td>8,451.16</td>
</tr>
<tr>
<td>1976</td>
<td>3,78,964.61</td>
<td>10,632.96</td>
</tr>
<tr>
<td>1977</td>
<td>2,91,867.13</td>
<td>6,406.98</td>
</tr>
<tr>
<td>1978</td>
<td>2,62,698.95</td>
<td>24,845.80</td>
</tr>
</tbody>
</table>

### THE FUTURE SCENE

It is undoubtedly true that Assam or, in a broader sense, the whole of the North Eastern Region requires an independent institute of the IPIRI standard. Such an institute should be a fullfledged institute with the facilities for education, training, research and technical detailing necessary for the plywood industry.

(I) To that end the Government of India should be requested for the establishment of such a plywood institute to impart education, training and research facilities.

(2) Such an institute should be autonomous and free from vested interest and its set-up should be something like the existing IITs.
(3) The problems of plywood industry, which are local in character, must be taken up by this institute. The problems of storage in wet weather which are peculiar to Assam must be taken into account and remedies for storing problems should be found out.

(4) There should be research studies to control wastage.

(5) There should be a regular course in plywood management and engineering.

(6) Better organisation and commercial viability of Assam's ply products should be thoroughly assessed and given better push up to suit the modern industrial and commercial needs.

(7) An extensive growth of raw material (that is timber) should be given a lead in planning through this institute. The formation of such an institute is already overdue and the early creation of such an institute must be given top priority.

NOTES AND REFERENCES

2. Ibid., p 97-98
3. Ibid., p 99


5. Ibid., p 13