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TRAINING IN WOOD DRYING AND KILN MAINTENANCE

DP/DMI/86/004

THE COMMONWEALTH OF DOMINICA

Technical report: Timber Kiln Operation*

Prepared for the Commonwealth of Dominica
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of R. A. Plumptre
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ABSTRACT

Three weeks were spent by the writer in Dominica, five days of which were spent in running a course on timber drying for nine regular and five part time participants on the course. The four main Organisations owning kilns in the country were represented. Moisture meters and wet and dry bulb thermometers were handed over to representatives of these organisations at the end of the course and they will later receive an oven and weighing balance for determining moisture content of wood by the weighing and oven-drying method.

A guide to timber drying was written during the assignment and has been issued by UNIDO bearing the symbol DP/ID/SER-A/1006.

Various firms involved with wood drying were visited and ad hoc advice was given.

A centrally placed wood drying facility would now seem to be worth considering in or near Roseau. It should either be run by private industry or by a quasi-Government organisation run on the lines of private industry.

ACKNOWLEDGEMENTS

The writer is grateful for the assistance and co-operation of many people in Dominica which enabled the setting up of the course at short notice and over a period of public holidays which made for extra inconvenience on their part. In particular he is grateful for the support and guidance of Mr Peter Azille who in spite of a busy programme gave his own and his staff's support towards making the course a success. He provided office accommodation and a great deal of assistance in procuring equipment and materials necessary for the course. Messrs Felix Gregoire and Michael Zamore of the Forestry Division also gave assistance.

Mr Lawrence Peters was of great assistance during the running of the course and provided accommodation, equipment, time and staff assistance which were most useful.

Participants on the course contributed greatly in making it stimulating and enjoyable for the writer.

Finally he is grateful to UNIDO and UNDP staff in Vienna and Barbados for information, assistance and advice both technical and administrative.

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I INTRODUCTION

The writer was employed on Project DP/DHI/86/004/11-01 for a month to work in Dominica to run a training course in wood drying, install measuring and monitoring equipment and to prepare a guide to controlling and monitoring kiln drying. A full job description is attached in Appendix 1.

After a day's briefing in Vienna and a further day in Barbados he arrived in Dominica on Friday 23rd October after working hours.

On Monday 26th October discussions were held with Mr P Azille, Marketing and Promotion Manager of the Industrial Development Corporation and dates for the course were arranged for 29th, 30th October, 2nd, 5th and 6th November. These dates were chosen because of two public holidays on 3rd and 4th November to celebrate Independence Day. A full itinerary is given in Appendix 2.

Invitations were sent out to potential participants and, because of the short notice available before the start of the course, they were also telephoned.

II THE COURSE

Considering the short notice given the turn-out was very good and a list of participants and their companies is given in Appendix 3.

The course followed almost exactly the form outlined in the writer's 1986 report "Study of Wood Drying in Dominica" and included here in Appendix 4.

Four moisture meters and hammer electrodes plus spare electrodes and batteries were brought out to Dominica and used in running the course and four wet and dry bulb thermometers were also brought out and used in teaching.

The electric, ovens and weighing scales which had been suggested for the course in the writer's 1986 report had not been ordered when he arrived for briefing in Vienna so a model of oven and weighing scales and weights were chosen from catalogues and UNIDO is ordering them for despatch to Dominica.

An attempt was made to find suitable ovens and scales in Dominica; a possible oven was identified but there were none in stock and no suitable weighing scales were found. One oven with a defective thermostat and an accurate weighing scale were found at Ministry of Works and Communications and borrowed for the duration of the course. The oven required constant attention and could not be left operating out of office hours.

The course was held at the Woodwork Training Centre of the Forestry Division and every co-operation was received from Mr L Peters, head of centre, who attended the course himself.

An attempt was made during the course to explain some basic theory of the behaviour of water, the nature of wood and the interaction of the two to enable participants to understand why wood dimensions change with moisture change; and why timber drying and control of it is vital to good quality wood products. The instruments were used to monitor temperature, humidity and moisture content and methods of presenting results, including the drawing of drying curves and graphs of relative humidity and temperature, were practised.

Wood defects and their causes, methods of air and kiln drying and different types of kiln were included in the course.

The principles of kiln drying schedules were given and instructions on operating solar kilns were handed out and discussed. Participants were co-operative and seemed keen to learn and increase their knowledge of wood drying. They all had a knowledge of wood and its behaviour but lacked some of the basic theory behind wood drying and seemed interested in going deeper into the subject. Books on wood drying brought out by the writer were borrowed and read.

Good discussions developed on problems encountered by them during their work for their respective companies. At the end of the course the moisture meters and wet and dry bulb thermometers were handed to a representative of each of the four organisations due to receive them and they signed as having received them. The necessary charts of temperature humidity and equilibrium moisture content to operate the equipment were also distributed.

III THE GUIDE

During the assignment a guide covering the subjects taught in the course was written entitled "A simple Guide to Timber Drying". It has been written as a document which could be used anywhere and is not specific to Dominica. Instructions originally written for operating the writer's own design of Solar Kiln have been modified to suit solar kilns in general and have been included as an annex to the Guide.

No attempt has been made to specify methods of operating other types of kiln as they tend to be specific to particular kiln types and designs and they are supplied by the kiln manufacturers concerned. This guide has been issued by UNIDO under the symbol DP/ID/SER.A/1006.

IV CALIBRATION OF MOISTURE METERS

Samples were taken of Gommier (Dacryodes excelsa), the commonest timber in Dominica, for calibration with the electrical resistance, moisture meters. This had to be done at short notice in the first three days before the course started. Eight samples were cut from two pieces of timber selected as being "nearly green" from Dominica Timbers yard and an attempt was made to follow the procedure outlined in Appendix 5. Problems encountered operating the oven and maintaining the right temperature and with the switching off of the oven delayed calibration. It was also necessary to let samples cool between each measurement of weight which took at least an hour and these operations were difficult to fit into the teaching schedule. It was not possible in the end to get a satisfactory calibration of the meter for Gommier with the defective oven. The Gommier was slow drying and the overheating of the wood in the oven resulted in darkening and possibly some charring. A careful calibration is necessary when the new ovens and scales arrive.

V VISITS TO INDUSTRY

Early on in the writer's stay in Dominica a visit was made to Ogheden Industries at Cochrane operated by a Swedish national who has installed an Ebac dehumidifier kiln and a considerable quantity of wood working equipment. The operation of the kiln was discussed and his kiln operator attended one day of the course. Discussions were held with Mr Southwell, General Manager of Dominica Timbers Ltd who has plans to install further timber drying kilns possibly using a solar system designed by Abrico in Canada. Visits were also made to Home Industries Co-operative Solar Kilns, Rafoul Furniture Ltd and construction work being done on the new Canefield airport terminal by them. A meeting was held with Mr T Sage of the Eastern Caribbean Natural Area Management Programmes Cottage Forest Industries Project and visits were made

to the Cheapside Furniture Store and North Eastern Timbers Sawmill at Woodford Hill where the kiln and possible developments of kiln drying were discussed.

VI GENERAL INFORMATION RELEVANT TO TIMBER DRYING

The total area of Dominica is about 74,000 ha of which some 45,000 ha have recently been inventoried for forest cover. Of this 45,000 ha some 29,000 ha are scrub, recommended protected forest areas or agriculture and some 16,000 ha are classified as Commercial Forest Land: (FD 1987). Between three and five million board feet (7075-11,792 m³) of logs are estimated to be sawn each year (Gregoire 1987) probably yielding about 2830-4717 m³ sawn from an area of forest of only about 150 ha. It is estimated (Sage 1987) that some 680 m³ per annum are being kiln dried by the major companies producing timber and about 420 m³ per year are being used for furniture manufacture. Kiln drying is also required for joinery and pre-fab housing.

Of the total sawwood a proportion, probably not more than 20%, is sawn by chainsawyers mainly cutting to clear trees for banana planting in agricultural land.

Of the firms operating kilns Dominica Timbers have a current kiln capacity of 94 m³ which, in theory, can be dried in three weeks providing an annual output of about 1500 m³ but problems of extraction of logs from the forest have slowed down production from the sawmill to well below this level. North Eastern timbers have been producing about seven times the volume of timber for which they have kilning capacity. Ogheden Industries are drying for their own use. Home Industries Co-operative is drying for its own use but may soon also be drying for the chainsawyers through co-operation with the Eastern Caribbean Natural Area Management Program, Dominica Cottage Forest Industries Project. The latter project is intending to build a second solar kiln for which there is already a kit in Dominica and together the two kilns would have a capacity of about 230 m³ per year.

In summary, therefore, Dominica Timbers is currently utilising only about a third of its large kiln capacity because of shortage of logs from the forest. North Eastern timbers only has a kiln capacity capable of drying about a seventh of its current production; kilns in roseau which could be used for drying for a range of producers in the area have a current capacity of 115 m³ per year and a potential capacity of 230 m³ per year. The Woodwork Training Centre Kiln is currently out of action because of the breakdown of its fans for air circulation which are inadequate for the job. The supply of two new fans and switch gear at the cost of about US \$900 would enable that kiln to produce about 60 m³ of kiln dried timber per year from green timber or 100 m³ per year if it was part air dried first.

VII CONCLUSIONS AND RECOMMENDATIONS

The wood using industry is developing fast in Dominica and kiln drying capacity is increasing. There is a strong demand for timber for a wide range of purposes and, to a large extent, there is currently a sellers market. In spite of this the mark up in price per board foot of timber for drying is about 25 cents EC (9.6 cents US) or US \$1.15 per cubic foot (US \$41 per m³). This is not a large mark up for a slow drying timber like Connier and leaves little room for profit. There is a general appreciation that much of the wood used in furniture and joinery is being used too wet. The major suppliers of timber, Dominica Timbers are at full stretch in supplying orders for kiln dried timber because of logging difficulties. Suggestions have been made by a number of people that central kiln seasoning facilities should be set up by Government to dry timber for timber users generally and to set up a standard

for timber drying. There is some merit in this suggestion but it would have to deal with large numbers of small orders of different sizes and species of timber and in practice would prove very difficult to do except with a large number of small capacity kilns. It would probably best be done by private industry or if Government-operated it should have a management with full power to "hire and fire", to set pay and conditions of employment and an accounting system similar to that employed by private industry. To some extent it is already happening with the co-operation between Home Industries co-operative and EC NAMP Cottage Forest Industries project.

If Dominica Timbers overcomes its logging problems the general situation on the supply of kiln dried wood will improve except for the chain sawn timber in the Roseau area and the timber produced by North Eastern Timbers. A drying capacity of 600 m³ per year would be desirable at North Eastern Timbers as opposed to the current 115 m³ and about 500 m³ capacity is needed in Roseau. Five to six solar kilns in each place would probably dry the timber as effectively as conventional kilns, at lower cost, and would give versatility in allowing different species and sizes to be dried in different kilns. Preliminary air drying for 2-3 weeks followed by kiln drying would be the most efficient way of using kiln capacity.

Kiln Maintenance and Repair

Only one firm, Dominica Timbers, mentioned the need for expertise on kiln repair and maintenance for their CEAF and Westair kilns. In the writer's opinion this would best be accomplished by sending an English speaking engineer out to that firm who would train staff of Dominica Timbers to carry out the correct maintenance with the option for other firms to send employers to join the course. Because the kilns are dehumidifier kilns the maintenance is likely to be largely specific to that type of kiln but could be valuable to others such as Ogheden Industries who have a kiln of the same type or, to a lesser extent, to the users of other types of kiln. Stock control was not studied in detail but problems of getting logs out of the forest have resulted in low production, inability to supply orders, rushed kilning, resulting sometimes in mixed charges of one and two inch timber and inadequate drying of the thicker timber. More efficient use of the kilns would be obtained if sufficient production and stock were available to air dry for 2-4 weeks before kiln drying. It would reduce the time the timber is in the kilns probably by as much as half, but would require adequate production in the first place.

Gommier is becoming recognised as a very attractive furniture timber in its own right but its gummy and siliceous nature make it difficult to saw and slow to dry. It also probably has large shrinkage and movement, although these have apparently not yet been measured, and therefore it requires careful drying to the equilibrium moisture content required for the job for which it is to be used. Considering the problems of handling it the price of kiln dried Gommier of EC \$ 2.10 per board foot. (US \$ 0.81) or US \$ 342 per m³ is not high. Given good marketing it should command a good price for furniture and high class joinery both locally and for export. The growing import of other more easily machined woods for building construction and utility uses seems a sensible longer term policy. Gommier is unlikely to be able to compete in the long term with other more easily handled low priced woods for construction. The same is true of some other local species.

Appendix 1

UNIDO

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

ASSISTANCE TO THE KILN DRYING OF THE WOOD INDUSTRY

JOB DESCRIPTION

DP/DWI/86/004/11-01

Post title: Expert in wood drying

Duration: One month

Date required: As soon as possible

Duty Station: Roseau, Commonwealth of Dominica

Purpose of project: To improve the quality of the output of the existing wood drying kilns in the Commonwealth of Dominica.

Duties: The expert will be attached to the Wood Work Training Centre of the Forestry and Parks Service of the Government. He will be expected to:

1. Prepare a guide to control, monitor and measure moisture content in kiln dried lumber and wood;
2. Prepare a syllabus for a course on wood drying;
3. Install measuring and monitoring equipment;
4. Train staff of the Centre and of three local companies;
5. Prepare (part of) a final report.

Qualifications: A University Degree in Forestry. Extensive experience with kiln drying and lumber and control and monitoring of moisture content. Ability to train.

Language English.

Background information: Upon the request of the Prime Minister of the Commonwealth of Dominica, a UNIDO consultant, Mr. R. A. Plumptre, went on a mission to assess the needs for wood drying in Dominica. The project development facility of the United Nations Development Programme (UNDP) financed this mission.

At present some eight kilns are operational in Dominica to dry lumber. Up until 1987, no kilns were in use. This rapid growth in kilning capacity was a response to a realization that for quality joinery and furniture manufacture, wood drying is essential. There has not however, been a corresponding growth in the capability to measure moisture content, temperature and humidity accurately in order to monitor and control the drying process.

Dominica has a total land area of 751 km². Of this, about 50% is covered with forests. The 363 km² of forest land contain extensive reserves of Gommier, a hardwood species. It is widely used in building construction and furniture and joinery manufacture.

The Government of Dominica is making a great effort to diversify the productive base of the country and to expand the manufacturing sector, including the wood processing sector.

With an increase of output in both quality and quantity of the wood processing sector, it is essential that there exists local capability to measure moisture content, and temperature and humidity accurately in order to monitor and control the drying process of wood lumber.

Since the present wood drying capacity in Dominica seems to be big enough for the present (and foreseeable future) demand, efforts should now be made to ensure the quality of the kilning process. This can be realized through the supply of equipment to measure moisture content and to train staff in using this equipment. Apart from this, a staff must be trained in maintenance of the kilns. At present there is a shortage in local expertise regarding maintenance, resulting in unnecessary breakdown and repair time. A (preventive) maintenance scheme could put an end to this problem. A list of the type of kilns in operation is in Mr. Plumptre's report which will be handed to the expert.

Appendix 2

Itinerary

<u>Date</u>	<u>Activities</u>	<u>Persons Met</u>
F 23/10/87	Arrived Dominica at 5 pm - to Evergreen Hctel.	
S 24/10/87	Weekend - Course preparation.	
Su 25/10/87	"	
M 26/10/87	IDC to set up course and see Forestry Division staff.	P Azille, IDC H Zamore, Forests Utilisation Officer Mr P Gregoire, Head of Forestry Division
T 27/10/87	IDC Woodwork Training Centre Dominica Timbers - collect timber	P Azille L Peters
W 28/10/87	IDC and Woodwork Training Centre	Sister Alicia of NE Timbers
Th 29/10/87	Course 8 am - 1 pm	
F 30/10/87	Course, Ogheden Industries	Mr Ogheden
S 31/10/87	Weekend	
Su 1/11/87	"	
M 2/11/87	Course	
T 3/11/87	National Holiday	
W 4/11/87	"	
Th 5/11/87	Course, visit to Charles Bros	Mr Charles
F 6/11/87	Course, visit to Fort Hall Hotel construction site	Foreman on site
S 7/11/87	Weekend	
Su 8/11/87	"	
M 9/11/87	North Eastern Timbers, Woodford Hill	Sister Alicia, Mr E Jerome, Mr T Drepaul
T 10/11/87	Home Industries Co-op and Cheapside Furniture Ltd	A J Rivière, Mr H Attidore
W 11/11/87	Dominica Timbers Ltd Raffoul Furniture Ltd To East Caribbean Natural Area Management Programmes	Mr D Southwell Mr A H Raffoul
Th 12/11/87	To Barbados	Mr T Sage

Other persons consulted included: Mr B Brown of International Institute. Small Business and Handicraft Enterprise Adviser. Mr T J Reigert, Division of Trade and Tourism, Organisation of American States.

Appendix 3.

List of Course Participants.

Name

Organisation and Address

Full time Participants

Mr H Frederick	North Eastern Timbers, Woodford Hill.
Mr E Jerome	North Eastern Timbers, Woodford Hill.
Mr F Henry	Dominica Timbers Ltd, Rawles Lane, Goodwill, Roseau.
Mr A Paul	Dominica Timbers Ltd, Rawles Lane, Goodwill, Roseau.
Mr L Peters	Woodwork Training Centre, Forestry Division, Roseau.
Mr H Attidore	Cheapside Furniture Store, 55 King George Street, Roseau.
Mr A Laronde	Cheapside Furniture Store, 55 King George Street, Roseau.
Mr A J Rivière	Home Industries Co-operative Rawles Lane, Goodwill, Roseau.
Mr H Cuffy	Home Industries Co-operative Rawles Lane, Goodwill, Roseau.

Part Time Participants

J Williams	(3 days)	Forestry Division Botanical Gardens Roseau.
M G Martin	(1 day)	Woodwork Training Centre, Forestry Division, Roseau.
R Piper	(1 day)	Ogheden Industries, Cochrane.
F Celestine	(1 day)	Cellos Furniture Supplies, Canefield.
E H Charles	(1 day)	E H Charles & Co Ltd, Goodwill, Roseau.

Appendix 4

Syllabus for Course on Wood Drying

The following is an outline of the course's content:

1 Effects of Water on Wood

- Water in cell lumens
- Water in cell walls
- Fibre saturation point and shrinkage

2 Wood Shrinkage and Swelling

- Wood shrinkage, swelling and movement
- Shrinkage in radial, tangential and longitudinal planes
- Effects of shrinkage on distortion and wood defects
- Effect of defects on wood products and wastage in use of wood

3 Defects in Finished Wood Article

- Cracking, warping and twisting of furniture and joinery. Degrade and unacceptability of product
- Loss of reputation and markets

4 Equilibrium Moisture Content (emc)

- Effects of humidity on emc
- Effects of temperature on emc
- Relative humidity, vapour pressure and temperature relationships
- Requirements for drying for different uses in different locations
- Methods of using tables of wet bulb depression and temperature to find relative humidity
- Methods of using charts of temperature and humidity to find emc

5 Air Drying

- Methods of stacking timber
- Orientation of stacks and sheds
- Air drying in open under stack covers
- End coating timber to prevent end split
- Sticker spacing and thickness
- Methods of block stacking to obtain square ended stacks with different timber lengths
- Measurement of emc reached by air drying
- Benefits of open stacks versus sheds

6 Kiln Drying

- Different kilns and principles of operation
- Steam heated
- Hot air types
- Dehumidifying kilns
- Solar kilns
- Methods of heating and powering
- Air circulation
- Venting
- Control of humidity and temperature
- Kiln schedules and their operation
- Reconditioning

7 Methods of Measuring Moisture Content of Wood

- Oven drying and weighing
- Theory and practical operation
- Calculation of moisture content %
- Electrical Resistance Moisture Meters
- Method of operation
- Measurement at different depths in timber
- Advantages and disadvantages
- Calibration of moisture meters for different timbers against oven drying and weighing, theory and practical operation

8 Defects in Drying, Reasons for them and How to Assess Them

- Collapse
- Case hardening (Fork test)
- Surface checking
- Splitting
- Distortion (cup, bow, spring and twist)

9 Importance of Drying for Product Quality

- Drying to correct end
- Low gradients of moisture in wood
- Variability within charges of timber
- Dangers of moisture pick up after drying
- Packaging to keep products dry
- Effects of drying on machining properties and wood finish