Utilisation of Sitka Spruce in Ireland

G. KNAGGS[1]

Introduction

IF one accepts that the primary purpose of forestry is to produce a crop of timber giving maximum returns to the grower, one must select a tree species which will both grow rapidly on available sites and produce material which is readily sold. In Ireland, Sitka spruce has occupied this role as a high-yielding species on poor soils and is now the dominant species in our forests. As these forests mature the output of spruce will increase greatly. Productivity forecasts clearly demonstrate the longterm importance of spruce to Irish wood-using industries (see Purcell, this issue). I therefore propose to look at the outlets for this material vis-a-vis its properties and necessary processing. To do so, the value of the final product must be considered. Whereas pulpwood may fetch up to £10/m^3, the value of sawlogs can be up to £30/m^3, yielding structural saw timber worth £90–£100/m^3.

Markets

1. Pulpwood. The major outlet for small diameter logs, thinnings and sawmill residues is as a raw material for the production of chipboard, hardboard and paper pulp. The turnover in these industries, almost entirely based on homegrown raw material, was approximately £10m. in 1976.

For all these industries, Sitka is an ideal raw material, being readily pulped or chipped, and pale in colour. While chipboard, hardboard and mechanical pulp plants can be expanded in stages at a reasonable cost, the introduction of a chemical pulp plant, comparable to the installation at Fort William in Scotland, would require some 300,000m^3 of raw material to produce 80,000 tonnes of pulp per annum. This, regarded as the minimum size for economic operation, is equivalent to almost the entire spruce smallwood available in 1982/83. Bearing transport costs and the competition for supplies with present plants in mind, it will clearly be quite some time before an investment of this nature can be considered. Investment in the other pulpwood industries will thus be essential to ensure full utilisation of the supplies becoming available in the near future.

2. Posts and Poles. In the past, Sitka spruce has been considered

1 Forest Products Department, Institute for Industrial Research and Standards, Dublin.

unsuitable for this market due to (a), in common with most species, its inherent lack of durability when in moist conditions, and (b) the difficulty of successfully treating it with preservatives. Recent work at I.I.R.S. (Institute of Industrial Research and Standards) has succeeded in developing a method whereby spruce can be pre-treated so that full sapwood penetration with creosote or water-borne preservatives can be obtained. In this process, bacteria are introduced into the poles while in water storage. Pectinolytic enzymes secreted by these bacteria break down the pit membranes in cells, thus providing pathways through which the preservative can subsequently travel. It is confidently hoped that this will enable the imports of Scots pine poles for transmission lines to be entirely replaced by homegrown spruce. This could result in an import reduction of £750,000 annually.

3. Sawn Timber. At present the market for sawn "white deal" which includes the spruces, hemlock and true firs, is, at 424,000m³, 68% of the total sawn softwood market, and is broken down as follows:

Category ...	Volume (m³)	% of total market
Construction	310,000	47
Furniture	16,000	22
Pallets & Packaging	49,000	12
Do-It-Yourself	10,000	1.5
Fencing	20,000	3
Miscellaneous	14,000	2

This should be compared to the availability of sawn homegrown spruces of 45-50,000m³ at present and a forecast of 100,000m³ in 1982/83. (This assumes a yield of 60% sawn timber from round logs). There should therefore be no difficulty in finding markets for all available sawlog material in the foreseeable future, if this is accepted as a suitable structural material.

We must therefore consider the properties of homegrown Sitka spruce in relation to its utilisation as sawn timber. Studies at I.I.R.S., sponsored by the Forest and Wildlife Service, have shown that the strength properties of this material are slightly inferior to those of the "white deal" presently being imported. As the quality of timber being imported is tending to fall, whereas that of homegrown is rising, this difference *may* diminish significantly in the future.

The strength of any species of timber is closely related to its density. Much homegrown Sitka has a relatively low density,

probably attributable to its often rapid rate of growth. In this instance, therefore, the requirements of a rapid growth for volume production, and a slower growth for maximum strength, are in opposition. Under visual stress grading rules a minimum of 4 growth rings per inch is specified for structural grades, more rapidly grown material being rejected for such purposes. Of necessity, however, these visual stress grading rules are conservative to ensure that all weak material is rejected. On testing, much of this material was found to be of adequate strength. To overcome this difficulty mechanical stress grading can be utilised. In this, the stiffness of each piece of timber is measured directly and due to the close correlation between stiffness and strength, the strength of each piece is measured. Thus any characteristics unacceptable under visual rules but found not to affect strength are ignored. Machine grading studies in Britain have shown that a yield of up to 70% of M75 grade can be obtained from Sitka spruce. This can compete directly with existing grades of imported material for such exacting end-uses as trussed rafters. In contrast, if visual grading were carried out, little if any material would reach 75 grade and up to 40% would be rejected entirely. (Grades: The prefix M indicates a machine grade and 75 indicates that the material has 75% of the strength of defect-free material).

Processing

To gain access to the high-value structural timber market for homegrown Sitka spruce market, it must be presented in a form in which it can stand comparison with imported timber. Three factors are of paramount importance in achieving this:

(a) *Moisture Content.* The moisture content of freshly felled spruce can exceed 200%. This must be reduced to a maximum of 22% for structural use in order to prevent subsequent excessive shrinkage and distortion and to prevent fungal attack. This can be achieved either by air or kiln drying. Air drying will take from 3-9 months depending on the timber thickness and time of year. Kiln drying, on the other hand can be completed in less than two weeks but necessitates the use of expensive plant and considerable quantities of heat energy. The processor must balance the cost of holding large stocks for considerable periods of time against these kiln-drying costs. Normally it will be found that kiln-drying is preferable where consistent quality is essential.

(b) *Sawing.* The building industry is today working to closer tolerances than ever before. Poorly sawn timber, which may need to be re-sawn or trimmed to fit, will not be accepted by the builder. Hence accurate sawing is essential for the co-ordination of structural timber with other building components. This is in the sawmillers

own interest as his yield in log conversion will fall dramatically if excessive tolerances must be allowed. The utilisation of modern band-saw equipment, properly maintained and operated will do much to ensure a quality product at an economic processing cost as compared to out of date or poorly maintained machines.

(c) *Grading*. The purchaser must be able to rely on the consistent quality of the timber he obtains in order to utilise it to advantage. Inconsistency in this respect can only reflect on the quality of homegrown timber in general and will retard its general acceptance. If, however, these steps are conscientiously carried out then there is no doubt that homegrown Sitka spruce will replace imported timber to the extent that supplies permit.

Discussion following the paper of G. Knaggs

CHAIRMAN: **T. Clear**

To **Mr. Parkin's** inquiry about the relationship between the number of rings per inch and timber strength, **Mr. Knaggs** replied that visual grading may only class 4-8% of fast grown spruce as suitable for structural grades. Mechanical grading would give a higher percentage of suitable timber, He said there was a good correlation between density and strength of timber. **Dr. Dunleavy** commented that the more rings per inch (or laminations per inch, as in plywood) the greater the strength of the timber. He added that future research would include an examination of density patterns for different sites and environments. **Mr. Mooney** inquired about the effect of spiral grain on timber quality and asked whether spiral grain was pronounced in Sitka spruce timber supplied to I.I.R.S. for testing. In reply, **Mr. Knaggs** said spiral grain caused deviations from straightness, fissures on drying and twisting. Some evidence of spiral grain had been observed in lots of small-sized timber recently received for testing. However, in moderation, spiral grain was tolerable. In reply to a query from **Mr. O'Kelly, Mr. Knaggs** said that the cutter knife angle was critical in the planing of Sitka spruce. **Mr. Quinn** asked about the effect of knots on timber strength. **Mr. Knaggs** said that the effect of knots on timber strength depended to a large extent on whether the knot was under tension or compression when the timber was in position.