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# Preparation of gum from Tamarind seed – and its application in the preparation of composite material with sisal fibre

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Methods were developed to prepare gum solution from Tamarind seed of good adhesive strength. A composite material of Tamarind Seed gum and the cellulosic rich sisal plant fibre was prepared and techniques were developed to increase the strength of the prepared composite material by a process of humidification and compression. The prepared composite material have potential industrial applications such as false roofing and room partitioning. © 1998 Elsevier Science Ltd. All rights reserved

## INTRODUCTION

Gums are high molecular weight substances, which in an appropriate solvent, produce high viscosity solutions at low dry weights. Many plants and bacterial polysaccharides, exhibit gum characteristics when they are dissolved in aqueous solution. Such products are in use in the paper, paint, food, pharmaceutical and textile industries (Sandford *et al.*, 1984). The seed material of *Tamarindus Indica* (a widely distributed species in India and South Asia) contains mainly polysaccharide material. Its structure, being xyloglucan polysaccharide contains a glucose backbone with xylose and galactose decoration as side chains (Aspinall, 1969; Gerard, 1980; Gidley *et al.*, 1991). It is widely believed that *in vivo* the xyloglucan form a strong hydrogen-bonding association with cellulose (Bauer *et al.*, 1973; Aspinall *et al.*, 1969) which has been substantiated by X-ray diffraction studies (Taylor & Atkins, 1985). In this work, attempt was made to prepare gum from crude Tamarind seed material and using this as a binder, trials were made to prepare a composite with cellulosic rich sisal agave plant fibre. Methods were developed to increase the strength of the composite by humidification followed by a compression process.

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## PREPARATION OF TAMARIND SEED GUM AND ITS BASIC PROPERTIES

Raw seeds of Tamarind were dried in sun light for a day or two and the whole seed was broken into small pieces and ground into a fine powder. Distilled water was taken in a beaker and the required amount of fine powder of Tamarind seed was mixed to give a solution of 4% w/v concentration. The powder could not be dissolved at room temperature. Hence the mixer was heated to 80°C to 100°C with a constant stirring of solution to avoid layer formation on the surface. The process required a minimum of two hours duration. Filtration was carried out hot, using glass wool to throw away the undissolved, mainly due to the skin of the seed. The undissolved material contained approximately 25% of the dry weight substance. The final solution obtained was of 3% w/v concentration.

The prepared gum solution had good flow property and also exhibited good adhesiveness. The adhesive strength was determined by measuring the tension at the breaking point of the adhesive surfaces where failure was purely at the adhesive junction. The test was carried out in the following way. The gum was applied uniformly all over the surface of two sheets of Executive Bond paper leaving the bottom margin ungummed (the bottom margin has a dimension $\frac{1}{10}$th of whole surface) and cut into pieces having a dimension of 30 cm×3 cm after drying in the sunlight. The experimental set up, shown in Fig. 1, was used.

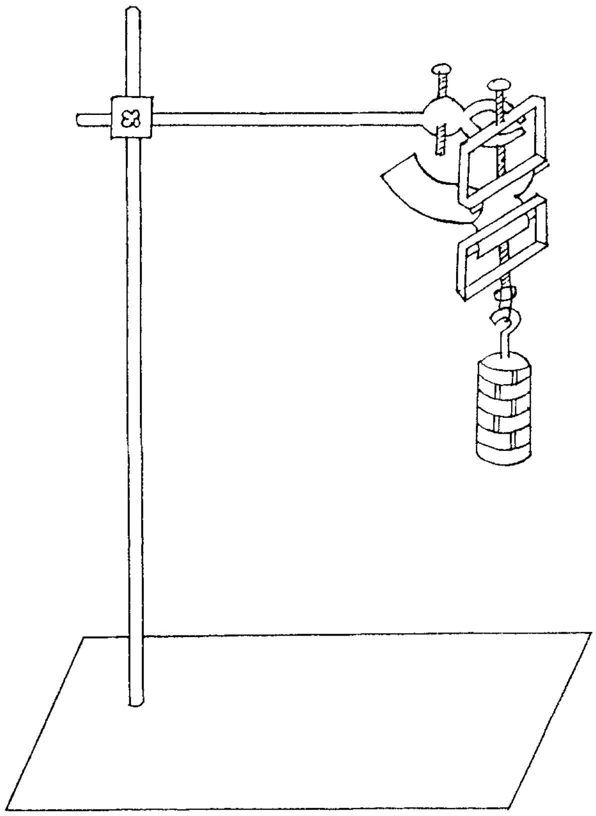

Fig. 1. Experimental setup to measure the adhesive strength of the gum.

Initially the weights were added at 10 g intervals but close to the breaking point the weights were added at an interval of less than 5 g. The adhesive strength was calculated using a simple formula,

$$\text{Adhesive Strength} = \frac{\text{Weight at breaking point}}{\text{Width of adhesive surface}}$$

The experimental value of the adhesive strength of gum solution was $117 \pm 11$ N m$^{-1}$. This value was compared with the adhesive strength of the gums available in the market, made by standard companies by carrying out a similar test. This indicated that Tamarind seed gum was as good as the marketed gums and could be an alternative source of adhesive, increasing the economic importance of Tamarind seed.

## PREPARATION OF THE COMPOSITE MATERIAL OF TAMARIND SEED GUM AND CELLULOSIC-RICH PLANT FIBRE (*SISAL AGAVE*)

As it has been indicated earlier, Xyloglucan which is present in Tamarind seed gum material can interact effectively with cellulosic structure of plant fibre, through hydrogen-bonding. Hence composite material preparation was carried out by mixing the Tamarind seed gum with cellulosic rich plant fibre of *Sisal Agave*.

The cellulosic rich sisal fibre was manually extracted from the leaves of the *Agave sisalana* perr ("Kattralai" in Tamil). Each leaf yields approximately 1 to 2 g of dry fibre. These fibres were cut into small pieces of length 1 cm to 2 cm. 10 g fibre was spread on a rectangular plastic tray of size 25 cm$\times$20 cm. 200 ml of Tamarind seed gum solution of concentration 3% w/v was uniformly mixed with it. The fibre–gum mixture was allowed to dry in sun light for about 12 hours. This yielded a composite material of Tamarind seed gum–sisal fibre (TAMSIS) as a sheet. The strength of the TAMSIS thus prepared was not appreciable (judged by manual testing). To increase its strength, humidification and compression was used. In the humidification process, the TAMSIS sheet was kept in a stand inside the plastic container which contains water equivalent to 10% of the total volume of the container. The container was closed with an air-tight lid. The whole set up was maintained at room temperature. This arrangement maintains a relative humidity of more than 90% in the enclosure. The TAMSIS sheet was kept inside the enclosure for about 12 h. As soon as the TAMSIS sheet was removed from the humidification chamber, the TAMSIS sheet was compressed by laying it between two steel plates using a nut and bolt arrangement. The pressure exerted on the TAMSIS was increased by tightening the nuts on the four corners of the plate. The TAMSIS was kept compressed for about 12 h at room temperature (25°C). The partly dried TAMSIS material was taken out from the compressing plate and dried fully in the sunlight (25°C to 35°C). The material achieved by this process was found to have considerable tensile strength. The tensile strength of the material was tested using a Houns field testing machine and it is found to be about 60 N m$^{-2}$. This affirms that composite materials with considerable strength can be achieved by mixing Tamarind seed gum with cellulosic rich plant fibres. For measuring the thermal conductivity of the TAMSIS material, Lees Disk method was employed. The thermal conductivity of the material was found to be 0.075 J S$^{-1}$ m$^{-1}$ K$^{-1}$ implying poor conductivity, thereby revealing that it could serve as a thermal insulator. The composite material also withstood drilling. The bore sizes we used for drilling this TAMSIS material were 4 mm, 6 mm and 8 mm. During the drilling process it did not crack or smear. Figure 2 shows one such TAMSIS sheet. This indicates that TAMSIS material lends itself to assembling by the use of bolts and nuts. The density of the TAMSIS material is found to be 400 Kg m$^{-3}$ indicating its light weight. TAMSIS, with its light weight and poor conductive nature, will be a good partition/roofing material that may be ideal for false ceiling in air-conditioned rooms and for room-partitionings. It is also ecological-friendly as it is prepared fully from natural substances.

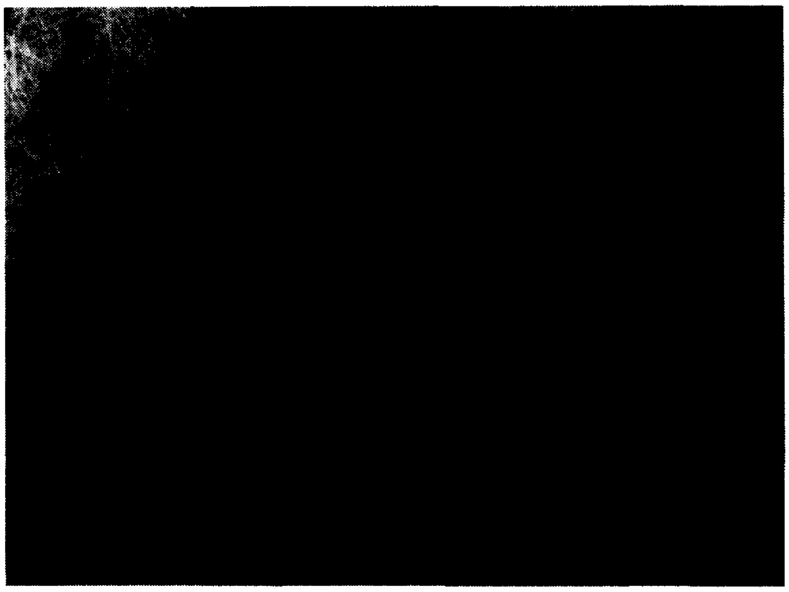

**Fig. 2.** Composite material of Tamarind seed gum and sisal plant fibre (TAMSIS).

As the solvent used for the preparation of Tamarind seed gum solution is water, TAMSIS material has to be protected from direct contact with water by water proof paints or by lamination, to which TAMSIS material lends itself easily.

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