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Borassus timber project in manufacturing brake linings for vehicles

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Abstract Brakes are the safety elements on a kinematic device. Wood is not suitable for making brake pads or linings. They ensure the immobilization function of the machine. The manufacture of Borassus wooden brake pads is the subject of this study.

Pads for disc brakes or linings for drum brakes generate intense heat due to friction. They are under enormous pressure when braking. The evidence is that natural wood is not indicated because of the areas and conditions of solicitations of the skates. In general, water alternates the resistance of wood and heat causes it to burn. Borassus, is a wood that has commendable advantages over water and heat. It no longer deserves treatments against xylophagous insects and water. To prevent this wood from smoking wear, it is immersed and kept in oil for about thirty days. The immersion of these pads in the oil makes the wood slippery.

This work is a project, a draft inspired by a model. Borassus is a wood with the qualities to experiment in the realization of brake pads. Treatment with oil and salt water would increase the resistance of this wood to stress.

Keywords Treatments, Borassus wood, exploitation, brake pads.

1. Introduction

Brakes are components that immobilze a vehicule. Its principle of operation is to transform the kinetic energy of the moving object into thermal energy (heat). The effectiveness of the brakes depends on the ability to dissipate heat quickly to prevent overheating causing burns. The brakes have lining made of high-temperature resistant materials. The materials of the trim are mostly sintered metal with some copper, asbestos, semi-metals, carbon-ceramic and organic materials. The mixture of these materials gives a composite material with a good coefficient of friction (0.35 to 0.40). Brake materials are sometimes made of rubber or reinforced carbon. In the years 2003, the platelets gradually wear out during their operation. They lose their materials in the environment.

The most common method of braking is to exert a retarding force by acting by friction at the periphery of the wheels. The braking force must always remain below the adhesion force. Braking effectiveness is based on the ability of its constituents to transform kinetic energy and thermal energy (heat) and absorb this heat and resist the coefficient of friction between them.

Far from being well appreciated in the use of brakes, wood is used for train shoes in Montreal. Canadians were inspired by Paris metro technology to make wooden brake shoes. Beech and cherry are woods used to make clogs. "All the clogs we use on the Montreal metro are made here," says Yves Duplessis, mechanical engineer at the Société de transport de Montréal (STM) [1]. Beech, the particular wood often used in the manufacture of hooves, has a density of 0.68 and a modulus of elasticity of 14,350 Nmm-3. Cherry, also used in the manufacture of hooves, has a density of 0.61 and a modulus of elasticity of 12,750 Nmm-3 [2]. Beech and cherry woods have inferior characteristics to borassus. Nevertheless, they are used in Canada for train clogs [1].

They are used for about 80,000 km on metros. Borassus will probably be more effective. The clogs are organs in the braking device.

The strength of wood varies according to the direction of the fibers, the moisture content, the density and the duration of growth. Wood has a density between 0.34 and 0.85 [3], sometimes up to 1.3 for ironwood [4]. Density and hardness are two characteristics to consider before making a good choice. Hardwood is resistant to shocks and scratches (H>9580 N with a density corresponding to 820 kgm-3). The modulus of elasticity (MOE) at bending also influences the choice of wood. In the case of braking, it is not a question of bending but of compression. Borassus having a high MOE at bending, will be much more resistant in compression.

Borassus being a particular wood by its morphology and constitution, its exploitation in the fields of construction leaves testimonies for its resistance. Although it is classified as false wood, its density is higher than or equal to some woods. Borassus is a tree with a cylindrical trunk but referred to as a false trunk [5] [6]. In the center of the column is a spongy part; all around which is a very hard, resistant and rot-proof crown. The modulus of elasticity at bending of the hard zone is about 19,000 Nmm-3 [7]. Figure 1 shows the stripped crown of the spongy part. In the best of cases, the hard outer crown is exploited in construction because of its mechanical value.

Following the example of Canadian technology, the wafers or fillings will, after cutting, be put in hot oil for a long time and then immersed in a salt solution. This treatment allows the linings to have less friction. Brakes are the safety elements on a kinematic device. The material used to manufacture the linings or inserts must meet the basic requirements: heat dissipation, low friction and coefficient of friction. The higher the coefficient, the faster the brake discs will deteriorate or wear out due to the greater abrasive power of the pads. Studies on the manufacture of wood trim remain very little and especially on Borassus. Pruning and initial trials suggest a long-lasting solution for platelet treatment.

The possibility of making Borassus wooden brake pads or linings to ensure the function of reducing movement or immobilizing the machine is the subject of this study. However, wood is not a good carrier of heat. The Borassus must undergo treatments to prepare it so that it can play its role. Linings are bound to wear and burn. Through this work a research track is left on the Borassus in the manufacture of linings, pads or brake shoes. The cut or shape to be given to the filling depends on the diameter of the crown. Figure 2 shows us this here.

2. Materials and Equipment Used

The material to be tested is Borassus wood. Slices of Borassus are taken from the stem. The stipe is a false trunk. The middle of the stipe is spongy, without mechanical value. A hard crown wraps around the spongy part. Figure 1 shows the hard crown of the Borassus that will be the subject of the work. The crown will be cut in the form of the desired lining, i.e. pads for the disc brake or lining for the drum brake.

Figure 1 (a): The Borassus plant

Figure 1 (b): Stipe emptied of the spongy part

There are two types of trimmings, namely hoof trims and pads. The shoes will be used on the drum brakes and the paddles on the disc brakes. On slices called slats, wafer samples are prepared in series on the Shopbot CNC milling machine. Inserts are cut and tested with this milling machine [7]. The figure 3 and 4 show the cut plate and its experimentation.

The hooves will be cut to the dimensions in the stipe while keeping the cylindrical shape of the crown. Figure 2.a shows the clogs of Montreal-Canada. Like the Canadian company, Borassus wood trim will be cut in a curvilinear way as shown in Figure 2.b.

Figure 2 (a): Canadian model of Brake shoe by Martin Cloutier

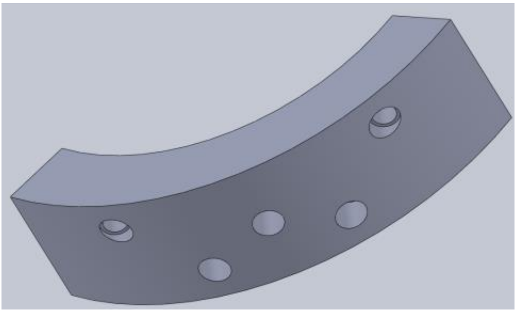

Figure 2 (b): Model of Brake shoe to be produced

The particularity of our Borassus wooden trim is that it will not have the locking groove but will have fixing holes (fig. 2(b). The trims will be aimed at the metal support in half hoop. They will not be as big as train hooves. The fixing will be made by gluing reinforced by screwing with embedded F90 screws. Here too, fixing screws will be used to block the trims on the metal structure.

Figure 3 shows the Toyota disc brake pad prototypes produced in Fablab's laboratory. These prototypes are made of Borassus wood. It is in its raw state without treatment.

Figure 3: The shape of platelets, prototype in Borassus

Proper treatment can prevent such wear and tear. Impregnating the pad with oil and then in flame retardant salt will change the structure of the filling. The oil will allow the seals to slide preventing the trim from reaching such a high temperature that can happen during sudden stops or prolonged friction. In addition, the contribution of flame retardant salt makes it difficult to burn the skate. Borassus has quite a few advantages in terms of mechanical strengths.

Figure 4: Pad tested on a car wheel

The treatment of these different skate shapes aims to change the behavior of the skates in case of stress. The pads or linings will be cut according to the model of disc brake pads or drum brake lining. Inspired by the Canadian model, they will be put in a basket and then immersed in the hot oil contained in a keg for about fifteen (15) days. During the fifteen (15) days, Borassus would have reached its saturation duration [8]. The basket containing the fillings or blisters will be removed from the barrel for drying for thirty (30) days. During these thirty (30) days, the oil will drain from the wood. The blisters or fillings are then taken back and are again immersed in a salt solution. Among the salts to be recommended, is boron salt for its flame retardant property making the product difficult to ignite.

3. Discussion

A drum brake consists of a drum inside which there is a mechanism with two jaws in the shape of an arc. On this arch-shaped jaw that will be mounted the filling by screwing. On the trims, lamé holes will be made to drown the head of the screws. The depth of the lamé hole constitutes the limit of use of the lining.

The braking of a wood trim is silent less noisy than friction linings. During the friction of the linings on the disc or drum, the fibers wear out. The result of wear is the smell of burnt wood in the presence of heat. However, wood is not a good conductor of heat, the heat energy produced remains accumulated on the friction disc and therefore on the wheel.

The enemy of wood is water and intense heat. The protection of wood is like coating it with a layer of oil. Not only to reduce wear, techniques of impregnation in oil and salt for several days can change the behavior of the wood. This technique also preserves the wood against destructive agents. In addition to these means to be put in place for treatment, brake discs can have grooves or small holes.

The salt technique will allow Borassus fillings to withstand heat. Salt has a relatively high melting point. Its presence in the wood, after a while, prevents the wood from burning in the heat. The trims will wear less quickly and resist friction. Salt also remains an agent for controlling insect pests that can harm the tree. But Borassus being rot-proof [6] [5], xylophages do not attack it.

All wood dries out when cut. Drying occurs with the vaporization of the water contained in the fibers, hence the contraction of the wood. But this is not the case for Borassus for contraction. Borassus is a very compact wood in the part studied. In our case, Borassus does not need treatment against destructive agents. Preparing it for sliding remains to be practiced because oiled wood is temporarily slippery.

The recommended treatments will reinforce the qualities of Borassus. The presence of the oil allows slippage and the salt prevents rapid wear of the filling.

4. Conclusion

The project to exploit Borassus wood in the manufacture of brake linings is an ambitious project. The stipe in its entirety is not conducive to this exercise. Only the hard crown is the indicated area. Treatments in oil and water resemble the quenching of fillings. This work is a foundation laid that deserves to be worked on, so a study with practical trials will justify the viability of the project.

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