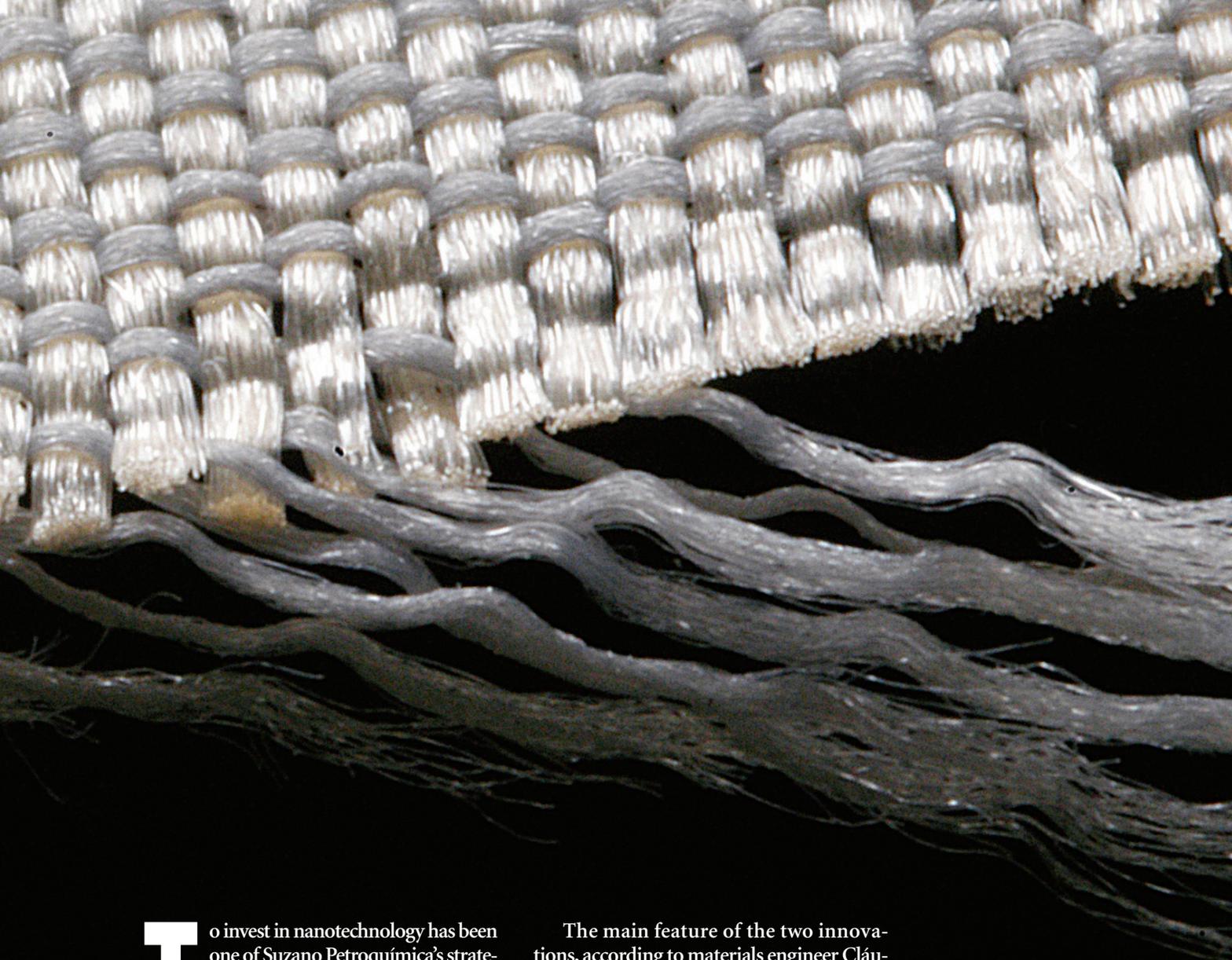


NANOTECHNOLOGY

Multiple uses

Nano-structured resins function
as bactericides and fungicides
in washing machines and mattresses

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To invest in nanotechnology has been one of Suzano Petroquímica's strategies in recent years, with the objective of embarking into new markets and expanding its businesses. The company is Latin America's leader in the production of polypropylene resins and Brazil's second ranked producer of thermoplastic resins, two versatile raw-materials employed in the manufacture of plastic packaging, containers for cosmetic and hygiene products, household appliances, automotive spare parts and textile products. Last May, on the occasion of Brasilplast 2007, the 11th International Exhibition of the Plastic Industry staged in São Paulo, the company displayed two products derived from nanotechnology research: a special nano-structured polypropylene with silver particles employed in the manufacture of household appliances in the white-ware line, such as washing machines and a new resin with nanoparticles for the manufacture of threads and fibers in the production of mattresses.

The main feature of the two innovations, according to materials engineer Cláudio Marcondes, the manager for development of new products at the company, is their bactericide and fungicide property. The petrochemical company expects that, within three years, approximately 10% of its income will derive from research in nanotechnology. "By using this new area of knowledge, we are adding value to our products", states Marcondes.

The new washing machine is being produced in partnership with Suggar, a domestic household appliance manufacturer with headquarters in Belo Horizonte. The appliance is among the first to be produced in Brazil using nanotechnology in the raw material. Nanotechnology – which is the construction of structures and materials on a nano-metric scale, with sizes equivalent to 1 millimeter divided a million times – permits the manufacture of products with differentiated characteristics, given that it modifies the properties of materials at the atomic level. Suzano's polypropy-

Fabric for mattresses containing thread with silver nanoparticles

Pipes at the bottom of the sea

During Brasilplast 2007, in addition to plastic resins with silver nanoparticles, Suzano displayed other products for the polypropylene market. One of them was a polypropylene specialty for the oil-drilling-at-sea sector. The new resin is used as a protection covering for offshore tubes deployed at great depths. "These pipes operate under extreme conditions and need to resist high temperatures, high pressure and the aggressiveness of the environment", emphasizes Cláudio Marcondes, the company's manager for the development of new products. They are made of special steel and sheeted with a protective, anticorrosive and thermally insulating layer of polypropylene. The thickness of this protective layer measures between 20 and 50 millimeters, guaranteeing the necessary temperature for the oil to flow.

The pipes are destined for wells situated at a depth of up to 2 thousand meters; however, Suzano is already studying the development of specializations comprising pipes geared towards even greater depths. The new polypropylene is sold to manufacturers of Socorril and Termotite pipes, which, in turn sell them to Petrobras. Suzano already meets the demands of the domestic market and its products have been employed in drilling sites in Roncador, Marlim and Albacora, off the coast of the state of Rio de Janeiro and has also exported the product to Angola. The company estimates that the polypropylene consumption potential for this sector will reach 5 thousand tons in 2007.

lene nano-structured resin with silver particles is employed in the manufacture of washing machine tubs, the part where the clothing is placed, thus conferring a microbicidal property to the component. The resin's disinfectant effect takes place by means of positive charges (ions) of the silver – a material whose bactericide property has been known for centuries on end – which attracts negative charges from the bacteria causing their cellular membrane to erupt, due to the difference in potential between the internal and external part of the microorganism, causing its death.

According to the industrial director of Suggar, Marcelo Emrich Soares, the new technology permits the elimination of 99.9% of the bacteria that develop in the tubs of washing machines, thereby conveying increased hygiene and quality to the clothes washing process. "The environment within the machine becomes exempt of contamination and ready to be used again. The new resin also confers increased resistance and durability to the product", claims Soares. For the time being, the polypropylene accrued from silver nanoparticles is being applied only in the line of semi-automatics washing machines, a segment in which Suggar accounts for a large market share, representing approximately 30% of its sales. But there is already an understanding between the two companies for the application of nanotechnology in other types of appliances. Until now, Suzano has supplied 100 tons of nano-structured polypropylene in the production

of washing machines. Given that each tub weighs approximately 6 kilos, the raw material is sufficient for the production of some 17 thousand machines.

Hygienic mattresses - The special resin employed in the manufacture of threads and fibers for mattresses is another result of the petrochemical company's research into new silver-nanostructured materials. According to Suzano, the development of the product demanded one year of research and its application is significantly diversified being used in hospitals, residential and hotel mattresses. Another advantage is that the product's bactericide property does not have a date of validity. Given that rendering a mattress hygienic is not an everyday process, the property of the resin contributes to the maintenance of a healthy environment, preventing the dissemination of infections. The resin is supplied to the Santa Catarina manufacturer of Döhler textile products, which already produces thread and fibers and supplies them to Castor, the company responsible for the manufacture of mattresses with nanostructured frames. "We believe that the product will be introduced into the market within two months", states Cláudio Marcondes from Suzano.

Suzano's nanotechnology projects are coordinated by the chemist Adair Rangel, who started the study and development of new nanostructured materials just three years ago, when he was completing his doctorate studies at the Chemistry Institute of the State University of Campinas (Unicamp). Dur-



Washing machine tub produced with polypropylene and silver: bactericide properties



Foodstuff conservation pot with silver nanoparticles: extended conservation period

ing that period R\$ 20 million was invested in nanotechnological research at the company's Technology Center. The unit employs some 40 researchers and technicians. Overall, the petrochemical company directs 1.5% of its billings of approximately R\$ 2.37 billion, to research and development of new products. To make the manufacture of hi-tech products feasible, the company has already started the construction of a specific production line, christened the Autonomous Extrusion Unit, situated in Suzano's factory at Mauá, in greater São Paulo. It will begin its commercial operation at the end of the forthcoming year with capacity to produce 24 thousand tons of special resins per year. The company's major challenge, according to Marcondes, is to develop not only new polypropylene resins with nanoparticles, but also to make them processable using the machinery already installed in the domestic manufacturing complex that purchases Suzano's resins.

During the past year, Suzano registered its first patent in nanotechnology, directed to obtaining nanocomposites with polypropylene and clay, resorting to a new method to render these two materials compatible. The resulting material displayed considerable progress in its mechanical properties, such as rigidity and resistance to impact, as well as a permeability-related barrier "We have not yet introduced any product based on its

use. Our objective, at the moment, is to show the potential of nanostructured polypropylene resins", states Marcondes.

Meat chopping board - One of the company's first nanotechnological products was revealed to the public at the end of 2006 during the 2nd International Congress of Nanotechnology (Nanotec) that took place in São Paulo. It was a polypropylene resin with silver nanoparticles - a pioneering version of the material employed in the manufacture of washing machines and mattresses. The primary application for this resin is the household appliance market. For this, Suzano developed prototypes of a meat chopping board and of a plastic pot to store foodstuffs. "The pot significantly increases the time the food may be kept", claims Marcondes. The meat chopping board, on the other hand, is free of contamination by bacteria lodging themselves in the grooves produced by the knife. "We are encouraging Reflet, one of our partners, to produce household appliances with nanostructured resin, which is approximately 10% more expensive than the conventional one", states the executive.

Suzano is also working on the development of films nanostructured with silver ions, which will be used in the production of packaging for fruits, foodstuffs and other products. Within a short time, the company expects to file for two new

patents related to other nanoparticles in areas of application with polypropylene, which for the time being cannot be explained in detail. According to Marcondes, the production volume of nanostructured resins is still quite small, but tends to grow as the population becomes aware of the value added to new products manufactured with them. "Nanotechnology is providing us with an unlimited potential. We are just at the tip of the iceberg", he points out.

With a capacity for producing 685 thousand tons of polypropylene resins per year, Suzano sells products in the domestic market to more than 500 clients and exports them to approximately 40 countries. Petrochemistry relies on three installations situated in Mauá, in Duque de Caxias on the Baixada Fluminense, and in the petrochemical complex of Camaçari in Bahia. Together, they account for more than 60 products. The company made up by domestic capital is controlled by Suzano Holding, which is also the major equity holder of Suzano Papel e Celulose. Investments currently carried out in the Mauá and Duque de Caxias plants are expected to increase the capacity of the petrochemical production by more than 190 thousand tons per year by 2008, thereby guaranteeing the company's leadership in the polypropylene business in Latin America. ■

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