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Theme: Ceramic, Composite and Polymeric Materials

STUDY AND APPLICATION OF DCPD TELENE, PU.R.RIM AND PP-TD 20 MATERIALS IN AESTHETIC COMPONENTS FOR TRUCKS*

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Abstract
The trucking industry is constantly seeking improvement and cost reduction of their vehicles, studying new lighter and robust materials to meet the needs of its customers. The objective of this work is to study the application of DCPD Telene, PU. R. RIM and PP-TD 20 materials in aesthetic components of trucks: bumper, calender, upper and lower bracket and side air deflector. A multifunctional work team was created to work in such parts of IVECO trucks. The work began with an analysis of possible improvements to the current parts and followed the subsequent phases: definition of new materials, virtual modeling, new tools, and durability test in vehicles. It could then be verified that the proposed DCPD Telene, PUR. RIM and PP-TD 20 materials showed greater strength, better painting surface, and reduced weight and cost in parts.
Keywords: Trucks; Polymers; Materials.

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1 INTRODUCTION

Since his creation, man has constantly been using his mobility in search of better living conditions or even to meet his needs. Earlier, the use of animals was essential for this movement. With the growth of cities and commerce, the need for machines that made faster and easier man's locomotion with families, food and other items arose.

Thus, over the years, with technological development, the automotive industry arises, which in Brazil came with the establishment of the Executive Group of the Automotive Industry - GEIA by the government of Juscelino Kubitschek de Oliveira. This has been considered the 1st milestone of the automotive industry in Brazil, since the GEIA made efforts, plans and initiatives for the domestic automotive park feasible.

In this domestic automotive park there are besides passenger cars, trucks and buses that transport cargo and people. They have customers who require products with characteristics that satisfy their needs and expectations.

Materials of great technical importance for this industry are "plastics" that present great advantages because of its low density, the possibility of being processed into complicated geometrical shape and with the required properties using the minimum work [1].

The so-called "plastics" receive the technical name of polymers, which correspond to large molecules having repeating units (called mers). Their dominant structure determines their response to the application of mechanical forces in high temperature conditions.

The behavior in a temperature rise generates a classification for these materials: thermoplastics and thermoset polymers.

Thermoplastics undergo reversible processes of: softening when heated and hardening when cooled. This is because as the temperature is raised the adjacent chains have their movement facilitated by diminishing strength of the connections [2].

When heat is applied to thermosets they become permanently hard and its connections will only be broken when heated to excessive temperatures leading to its degradation. When compared to thermoplastics, thermosets are harder and more resistant, but also have better dimensional stability [2].

Plastics have many applications in trucks. They have demonstrated high levels of reliability and advantages over traditional materials, such as reduction of: weight, CO2 emissions, cost, and production time. Besides, they offer the possibility of more modern designs and increased resistance to corrosion, to name a few. Some important examples of polymers applied in this industry will be discussed in the next paragraphs [3].

DCPD corresponds to a thermoset that has high impact resistance, flexibility and rigidity, quality surface finish, corrosion resistance, great resilience, low density, and excellent electrical insulation properties. In Figure 1 we can observe the properties of DCPD Telene 1752.

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Telene

Preliminary Data Sheet
TELENE 1752 typical properties

Properties	Standard	Unit	Telene 1752
Specific Gravity	ASTM D792	na	1.0
Tensile Modulus	ISO 527	MPa	1800
Tensile Strength @ Yield	ISO 527	MPa	43
Elongation @ Yield	ISO 527	%	6
Flexural Strength	ISO 178	MPa	66
Flexural Modulus	ISO 178	MPa	1755
Impact Strength (notched Izod) 3 mm sample @ +23°C	ISO 180	kJ/m²	24
Glass Transition Temperature		°C	145
Heat Distortion Temperature Under 1.8Mpa Load	ISO 75	°C	116
Linear Thermal Expansion	ASTM D696	m/m/°C	na

Figure 1. Technical Information of DCPD Telene 1752.

Data Sheet PU. R. RIM ELASTOMER SRD 410 20% GLASS FIBER

PROPERTY	UNIT	TEST	VALUE
DENSITY	KG./mc.	DIN 53420	1200
FLEXURAL MODULUS	MPA	ASTM-D 790	900
HARDNESS	SHORE D	DIN 53503	56
ELONGATION AT BREAK	%	DIN 535304	200
SAG TEST 1h A 120C°	mm	SAG TEST	3
COEFICIENT OF THERMAL EXPANSION	10^{-6}/K	VDE 0304/1	90
IMPACT STRENGTH	KJ/mq.	DIN 53453	NO FAILURE
IMPACT STRENGTH	KJ/mq.-30C°	DIN 53453	50
TENSILE STRENGTH	N/mmq.	DIN 53504	23

Figure 2. Technical Information of PU.R.RIM.

The thermoplastic PE 200.70 (PBT / PET-GF 20), has good mechanical properties, formability, dimensional stability and surface appearance.
The thermoset SMC R33 LS, has a coefficient of expansion similar to metal materials, high stiffness and high temperature stability.
In turn, the 65.25 PP (PP-TD 20) is a thermoplastic of good formability, rigidity, resilience as well as high resistance to chemical agents.
The thermoplastic ABS 95.150 has average mechanical strength, good resistance to chemical agents, impact, heat, and considerable rigidity. The PC + ABS 115.600 has high mechanical strength.
PU.R. RIM, a thermoplastic that is also applied to parts such as fenders, bumpers, brackets, tips, mudguards , blende, air intakes, headlight mask, air deflectors, handle, grids, battery cover, fairings, and mirrors, possesses properties which are shown in Figure 2.

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The objective of this work is to study the application of DCPD TELENE, PU. R. RIM and PP-TD 20 materials, in the following aesthetic components of trucks: bumper, calender, lower and upper bracket (top fender) and side air deflector.

2 MATERIAL AND METHODS

For the study of application of new materials in the outer parts of the truck cab, bumper, calender, upper and lower bracket, and side air deflector, it was firstly formed a group with people of cabin areas, supplier quality, purchasing , tooling, quality, documentation, structural calculation, testing, as well as people from management and the supplier POLIRIM.
With the formed team, possible opportunities for improvement of the current projects of vehicles TECTOR and CURSOR from the automaker IVECO Latin America were located. Proposals for new materials and sub division of parts with replacement of some fixed parts to mobile ones (called “inserts”) were made.
The "inserts" facilitate the painting process eliminating the masking time of the black parts, and assist in an eventual breakdown when only the damaged part would be needed to be exchanged.
Then 3D drawings of the parts were made, going after their approval. Those responsible for the financial analysis of the study group quoted the values of the new parts and a comparison with the old values was made.
Virtually approved the construction of tooling and of the first samples undergoing testing in vehicle rideability and durability were released. With the final approval, the parts entered the production line of the company.

3 RESULTS AND DISCUSSION

In Figure 3, the positioning of parts whose modifications were studied are shown.

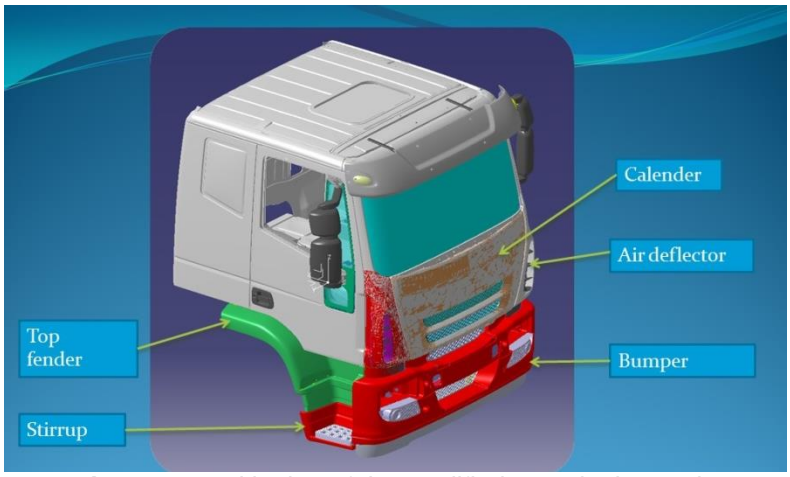

Figure 3. Positioning of the modified parts in the truck.

The best material options for such parts were then defined. Amongst them were chosen materials of high strength used in agricultural machinery and trucks, being them DCPD TELENE, PU. R. RIM and PP+TD 20, as shown in Table 1. At this stage it was also decided that changes in materials should not be accompanied by changes in dimensional parts.

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Table 1. Materials chosen for the modified part

	CURRENT	PROPOSED
Bumper	PE 200.70 (PBT/PET -GF 20)	DCPD TELENE
Grids and accessories	PE 200.70 (PBT/PET -GF 20)	PP 65.25 (PP- TD 20)
Front Skirt	PE 200.70 (PBT/PET -GF 20)	PU.R.RIM
Calender	ABS 95.150	DCPD TELENE
Lower Bracket	SMC LS R33	DCPD TELENE
Upper Bracket	SMC LS R33	DCPD TELENE
Side deflector	PC + ABS 115.600	DCPD TELENE

In the bumper, divisions of the parts were made. Attachment points were modified with the addition of a new support as well as changes in ribs, as explained in Figures 4, 5 and 6.

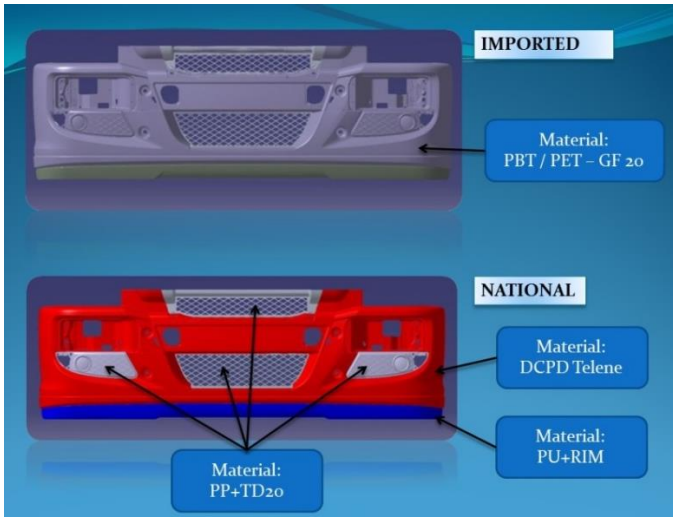

Figure 4. Comparative imported and nationalized bumper.

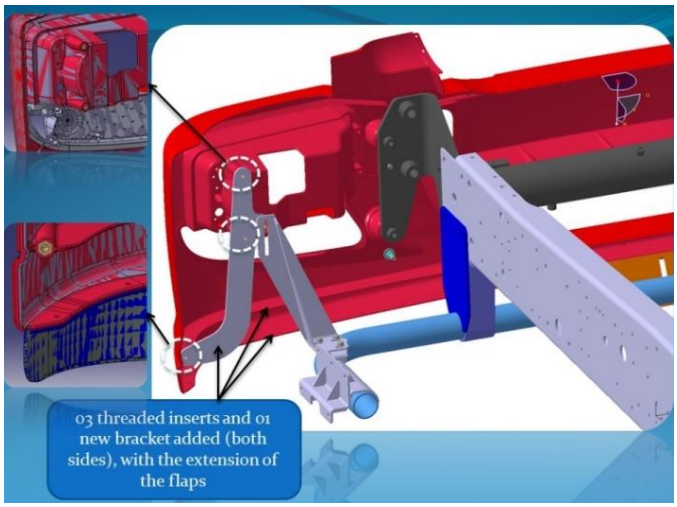

Figure 5. Location of the new bracket.

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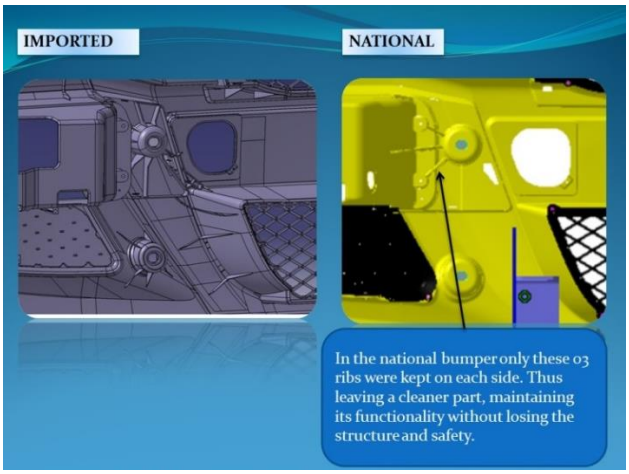

Figure 6. Changes made in the rib.

In the case of the calender, Figure 7, apart from the change of material and replacement with mobile grids, changes were made to the attachment points for more rigidity of the parts.

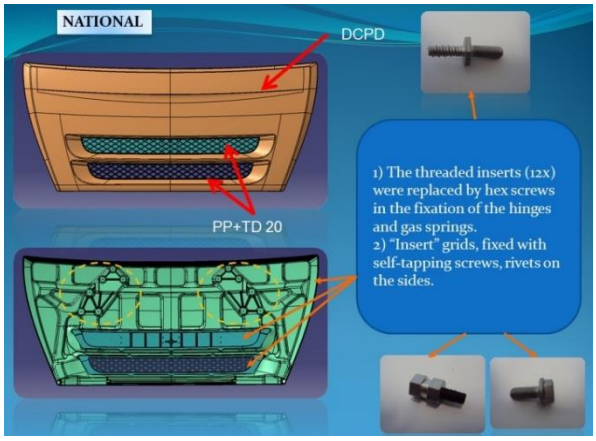

Figure 7. Nationalized calender with the proper changes.

At the lower bracket, the geometry for the support grid was modified so that it obtains more robustness. It also occured a change of material, which can be seen in Figure 8. It was also adopted the use of metallic inserts for better fixation and four brackets have been removed since it has been conferred a higher resistance to the part due to changes made, see Figure 9.

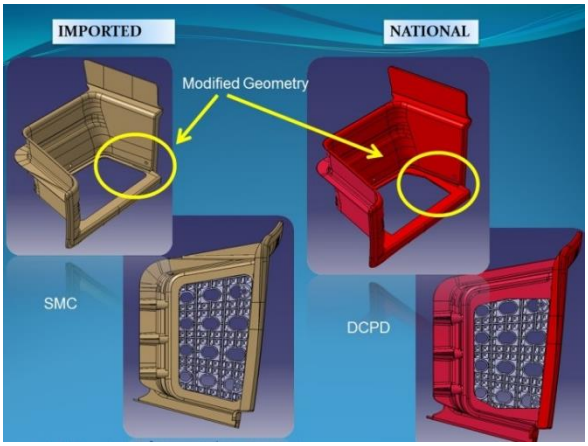

Figure 8. Comparative imported and national lower bracket, changes in material and geometry.

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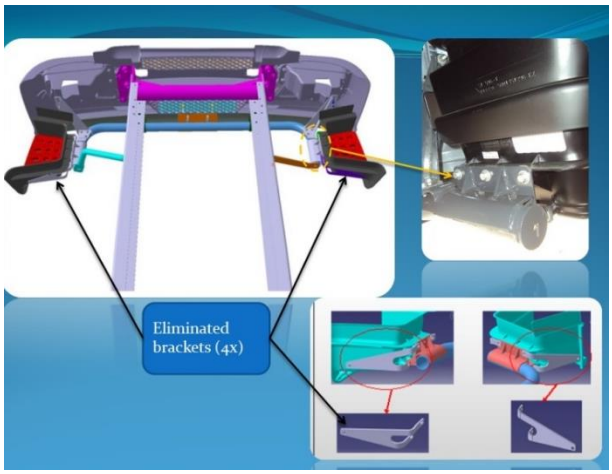

Figure 9. Brackets eliminated with changes made to the lower bracket.

The upper bracket (fenders) of CURSOR needed to be higher due to the difference in cabin height when compared to TECTOR. Like this, a complement was fixed in the imported part, as in Figure 10. With a proposal of modification of the mold parts beyond its material, it was possible to produce the two versions in the same mold, which led to the elimination of the complement and its brackets.

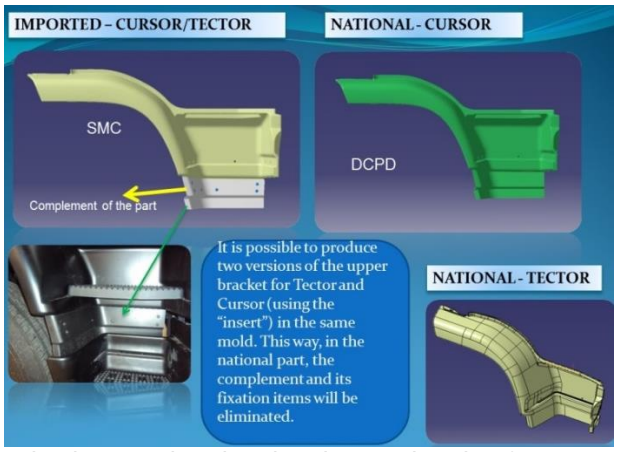

Figure 10. Comparative imported and national upper bracket for TECTOR and CURSOR.

Besides the change in materials, the inner and outer parts of the side deflectors had their geometries modified, where the inner part has started to only compose the wings, as in Figure 11.

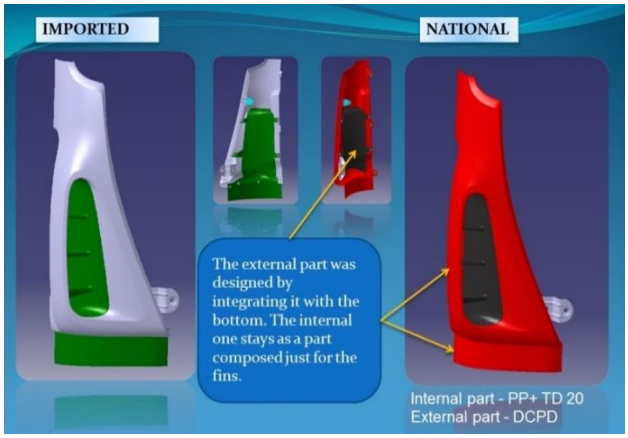

Figure 11. Comparative imported and national deflectors.

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Comparing the values of aesthetic packages items previously used and new (national), the new proposal has brought a 22% reduction in the total amount. The individual values are shown in Table 2.

Table 2. Percentage change in the value of old parts

	% change in value of old part
Full Bumper	+ 10%
Calender	- 37%
Lower Bracket	- 39%
Upper Bracket	- 38 %
Side Deflector	- 14%

In the field of weight, the total reduction of the package was of 25%. The individual values of each item are shown in Table 3.

Table 3. Percentage reduction in the weight of old parts

	% reduction in the weight of old parts
Full Bumper	38,5
Calender	4,4
Lower Bracket	22,6
Upper Bracket	33,1
Side Deflector	24,5

In the rideability test, no problems were registered. The initial goal of the work that corresponded to an improvement in the quality of the parts without their visual modification was reached.
Concerning durability, the new parts were assembled in various vehicles in which runned thousands of miles on unpaved road being subjected to severer conditions. The results were also satisfactory and all parts were approved in the field of quality.

4 CONCLUSION

The application study of DCPD Telene, PU. R. RIM and PP- TD 20 materials in parts of the aesthetic package of trucks: bumper, calender, upper and lower bracket, and side air deflector, led to satisfactory results by a significant overall cost and weight reduction, of 22% and 25%, respectively. Beyond the initial project fidelity to be maintained since no changes were made in its geometry.
Cost and weight reductions were accompanied by an improvement in the surface for parts' painting, as well as greater convenience with the presence of mobile parts called "inserts", as these can be removed for such a process.
The increase of modified components' robustness was also verified. This will lead to a consequent increase of customers reliability.

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