TECHNICAL BULLETIN
NEW PRODUCTS: ROTOMOLDED DESKTOPS

1 Introduction

Current global trends on the migration from wood to plastic, in addition to the growing interest in reducing deforestation, add to the advantages associated with the reduction of production costs in the long term, the possibility of increasing ergonomics, avoiding damage to people and /or loads with sharp objects, among other design advantages that can be optimized with the use of plastic. The rotomolded plastic desk represents a clear example of this.

In Poliolefinas Internacionales, C.A. Polinter we are willing to collaborate and undertake new initiatives that promote the use of Polyethylene resins, trademark Venelene® that we produce, in a friendly way with the environment. For this we have the support of the Indesca team who together with our Marketing Management led the design of the Rotomolded Desk.

This project has been framed in several stages, where its original design was subjected to a pilot test that allowed it to be optimized and obtain a desk that was adapted to the needs of the users for whom it was intended.

The effort made by the team was compensated when the design of the Desk won the "Single Part" award in the international design competition ("International Design Competition") of the Society of Plastic Industries of the USA (SPI) at the NPE/ANTEC triennial exhibition held in 2009, in the city of Chicago.

Figure 1. "Single Part" Award in the International Design Competition, NPE/ANTEC 2009.

2 Project phases

Starting from the idea of replacing conventional desks with those made of plastic material, during 2006 activities associated with the design for a model to be manufactured under the rotational molding processing technique began. This work continued in 2007-2008, where the models to be developed had to follow the COVENIN standards from 3 to 5i, aimed at users of different ages, weights and heights.

For the manufacture of the Rotomolded Desk, used Medium Density Polyethylene (PEMD) Venelene® grade 8407 APUV. Your initial prototype was subjected to pilot test in institutes that defined the successive steps to optimize its mechanical performance and include the modifications suggested by students.

3 COVENIN Standards 3, 4 and 5: Desk Rotomolded. Single Part Award

The final measurements of each model of the Desk are adapted to the COVENIN 1650-89[ii] Standard, to comply with its specifications of use:

- Desk Model 3: Standard COVENIN 1650-89 version 3, for users between 128 and 140 cm tall.
- Desk Model 4: Standard COVENIN 1650-89 version 4, for users between 141 and 157 cm tall.
- Desk Model 5: Standard COVENIN 1650-89 version 5 for users of height equal to or greater than 158 cm.

The generalized model of the desk is shown in Figure 2. In the design, special attention was paid to user ergonomics. Proof of this is the distance between the seat and the bottom of the board (legroom), which guarantees the comfort and quality necessary to make the desk a true innovation in design, manufacturing and end use.

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i Schemes 1 and 2 consist of seats for infants and, for their part, models 3, 4 and 5 are desks for users up to 1.60 m tall.

Ii Covenin Standard 1650-89: School furniture. Integrated desk, table and chair.

Figure 2. Desktops, generalized model

In all the prototypes made, the design validation was carried out through computational simulations of static load that allow studying the performance of the desks in situations to which they will be subjected during their useful life.

The state of charge was established as follows (See Figure 3):

- Desk Model 3:
  Seat load: 60 Kg.
  Load on the back: 27 Kg.
  Load on the table: 5.5 Kg.

- Pupitre Modelo 4:
  Seat load: 80 Kg.
  Load on the back: 36 Kg.
  Load on the table: 5.5 Kg.

- Pupitre Modelo 5:
  Seat load: 100 Kg.
  Load on the back: 45 Kg.
  Load on the table: 5.5 Kg.

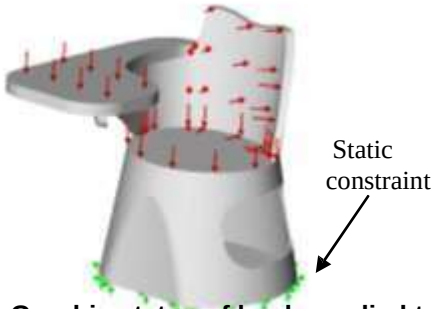


Figure 3. Graphic status of loads applied to the table, seat and backrest (in red).

The material used was PEMD grade Venelene® 8407 APUV. Within the simulation parameters, a wall thickness of 5mm was established, which allowed estimating the final weight of the desk. Among the most important results are:

- Desk Model 3: with a weight of 5 Kg, the maximum load displacement was 18 mm, the maximum stress was 9 MPa, with a safety factor (FS)iii of 3.1.
- Desk Model 4: with a weight of 6 Kg, the maximum displacement was 16 mm, the maximum stress was 6 MPa, with a FS of 4.5.
- Desk Model 5: with a weight of 8 Kg, the maximum displacement was 28 mm, the maximum stress was 7 MPa, with a FS of 3.9.

These results allowed the first full-scale prototypes to be carried out, to be evaluated by a population of students, through surveys of satisfaction.

3.1.1 Design safety and comfort.

To verify the safety of the models designed impact simulations were carried out due to falling a concrete block (500 Kg) on the desk. This simulation aims to recreate a situation of natural catastrophe (earthquake) that could put in risk the lives of users. The results of the simulations are shown in Figure 4.

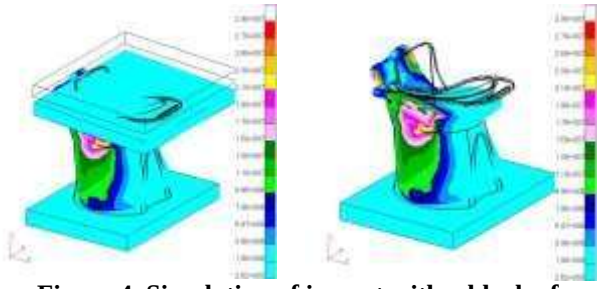


Figure 4. Simulation of impact with a block of 500 Kg.

iii FS indicates the number by which the applied load must be multiplied for a failure to occur, in this case, the failure occurs when applying 186 Kg (3.1 x 60 Kg)

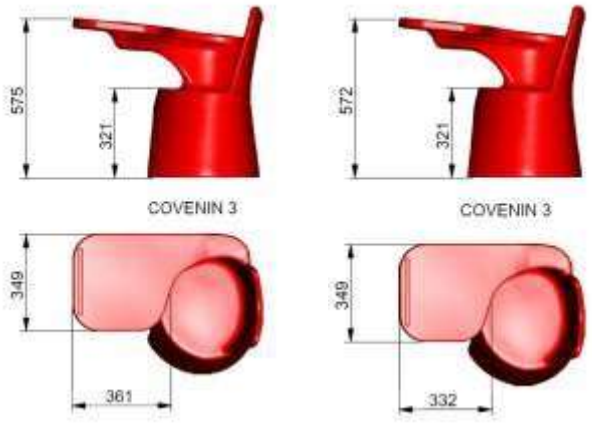
The simulations indicated that, after this impact, the structure of the desk does not collapse, reaching deformations of up to 12 cm, but leaving a space of 52 cm between the plate and the ground, which increases the user's chances of survival in this scenario.

3.1.2 Satisfaction surveys and final optimization of the models.

A survey was conducted to the students of the E.T.C. Dr. Manuel Dagnino (Maracaibo), an institution to which 40 desks were donated and are being used in an eighth grade classroom. The results obtained indicate that:

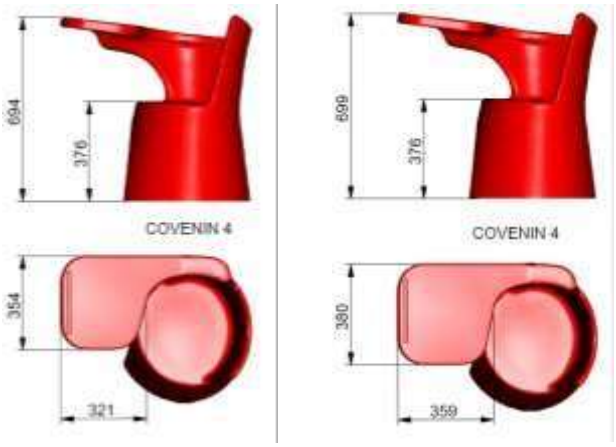
- ✓ 83% agree with the change of current desks for plastic ones, because they offer greater comfort.
- ✓ 78% found it more comfortable to write on the plastic desk
- ✓ 96% of students found the posture much more comfortable.
- ✓ 83% stated that the plastic desk is more safe and less noisy.

Some recommendations made on the COVENIN 3 and 4 models aimed at improving the upper tables of the desks; For this reason, dimensional changes proportional to the size of the desks and aimed at improving their ergonomics and aesthetic appearance were included. The initial and final dimensions of each model are shown in figures 5 and 6.



Before modifying End dimensión

Figure 5. Dimensions of Model 3 before and after modify.



Before modifying End dimensión

Figura 6. Dimensiones del Modelo 4 antes y después de modificar.

The educators, for their part, expressed their agreement with the replacement of the desks, due to their ergonomics and safety; agree with the students that plastic desks, due to their ergonomic design oriented to the proper posture for writing, benefit the students' learning capacity.

4 Plastic Desks: Innovation, Comfort and in Harmony with the Environment.

Without a doubt, this type of avant-garde design allows us to glimpse the potential advantages offered by plastic in various applications of global interest. In Venezuela, the substitution of wooden desks for plastic ones would represent a technological and leadership advance. Current trends in ergonomics, comfort and user safety are the common goal to follow, which is why the plastic desk is the best option to choose for educational institutions.

Finally, the plastic desk, made of polyethylene, is an important ally in the conservation of the environment. Its use not only reduces the indiscriminate felling of our forests and the use of metallic components, but at the end of its useful life, it can be ground and the material obtained used to manufacture new products or form part, as a percentage, in the making new desks.

5 Bibliographic references

1. Bohórquez, Joel. "Rotomolded Desks – Covenin Models 1 and 2", Project PLT-P-0207-07-03, Indesca, 2007.
2. Bohórquez, Joel; & Linares, Jesús. "Development of Rotomolded Desks - Covenin 3 to 5", Project PLT-P-0208-02-01, Indesca, 2008.
3. Bohórquez, Joel. Development of Rotomolded Desks - Covenin 3 to 5", Project PLT-P-0209-02-01, Indesca, 2009.
4. Editorial team of Tecnología del Plástico, "Rotomolding Supplement", cited on July 6, 2010 http://www.plastico.com/magazine/TPSupplementROTO09.pdf.

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