



MODULAR STRATEGY

NEW ARCHITECTURE FOR FRONT-END MODULE: *TECHNICAL MODULE*

■ DESCRIPTION

- The front end module is split in two sub-modules: a technical sub-module carrying main FEM functionalities (cooling, beams, latches...) and a design sub-module carrying the body and aesthetic parts (bumper cover, headlamps...).
- The technical module which is similar in shape to a FEC is dedicated to the mechanical behaviour. But contrary to an usual FEM, it does not warrant the gap and flush as it only integrates « non visible » (but standard and common elements) like cooling module, impact beam, water tanks....
- A specific hybrid metal/plastic technology has been developed bringing high stiffness in a reduced space. Thus good NVH behaviour is achieved for the vehicle and function integration for FEC is possible.

■ ADVANTAGES

- Simplified part with high stiffness.
- More robust assembly process for the car manufacturer.
- No need to carefully assemble heavy elements such as cooling system, beam (no geometry required for this separated module).
- More « compact » module in the X and Z directions (pedestrian safety needs).

■ INDUSTRIAL PROPERTY

- Patent pending

■ APPLICATIONS

- On-going pre-study.



MODULAR STRATEGY

NEW ARCHITECTURE FOR FRONT-END MODULE: *DESIGN MODULE*

■ DESCRIPTION

- The front end module is split in two sub-modules: a technical sub-module carrying main FEM functionalities (cooling, beams, latches...) and a design sub-module carrying the body and aesthetic parts (bumper cover, headlamps...).
- **The design module** - which is made of a semi-structural frame and the bumper skin - is dedicated to the perceived quality: the final geometry is warranted by the product, and not by the assembly process and/or means. The semi-structural frame has many functions: support for skin (rigidity, sun heat resistance), function support and integration (sensors, antennas, headlamps) and impact management (4kph ECE 42, pedestrian protection).

■ ADVANTAGES

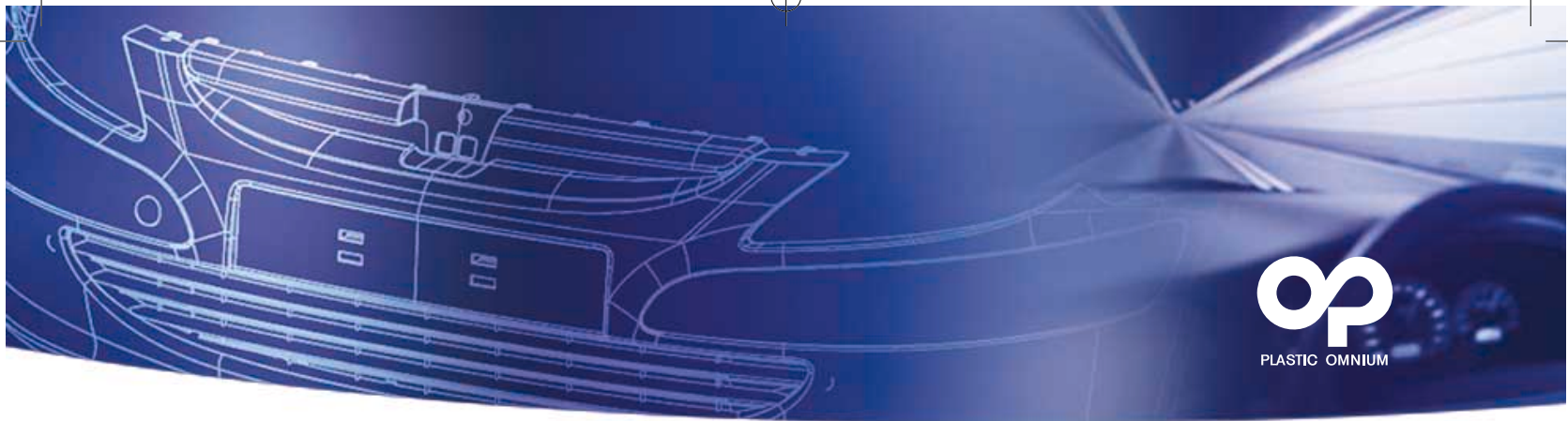
- Headlamp and fender/bumper gap and flush management.
- Final geometry warranty by the product itself.
- Easily recyclable: bumper skin and armature made of TPO.
- Many function integrations: electronics, communication, aerodynamic, impact...
- Interior trim integration, reduces parts number and weight.
- Reparability/recycling.
- Impact behaviour (low speed impact and insurance impact).
- Ergonomy on assembly line.
- Electromagnetic transparency.

■ INDUSTRIAL PROPERTY

- Patent pending

■ APPLICATIONS

- On-going pre-study.



MODULAR STRATEGY

REAR-END MODULE: MAX concept

■ DESCRIPTION

- Rear End vehicle re-engineering involving rear gate, floor, bumper and fascia, vehicle structure.

■ ADVANTAGES

- Impact selective management.
- Rear diversity management on a single platform.
- Repair cost reduction.
- Investment reduction.
- Restyling time-to-market reduction.

REAR-END MODULE: TAILGATE WITH DISMANTABLE TP OUTER SKIN

■ DESCRIPTION

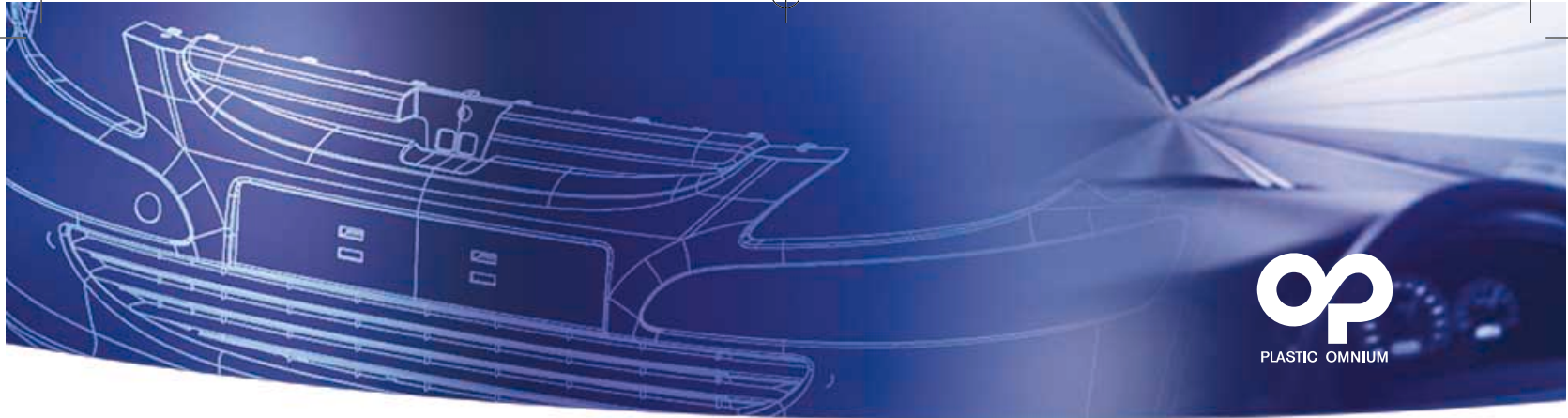
- TP outer skin screwed/clipped on a moulded in colour TS or TP inner structure.
- Off-line delivery.
- Equipment assembly and sequencing possible or bare parts delivery for assembly on car maker line.

■ ADVANTAGES

- Weight saving (25% - 4 kg average) and investments savings (40% - 5 M euros average) versus steel.
- Compared with existing TS solutions: part cost reduction, and application for high volume productions.
- Interior trim integration, reduces parts number and weight.
- Reparability/recycling.
- Impact behaviour (low speed impact and insurance impact).
- Ergonomy on assembly line.
- Electromagnetic transparency.

■ APPLICATIONS

- 100% TPO tailgate's liftgate development on progress.



MODULAR STRATEGY

FENDER MODULE

■ DESCRIPTION

- The painted front fender is pre-assembled on a carrier integrating numerous functionalities:
 - Headlamps,
 - Wheel arch and air guide,
 - Acoustic dampening system,
 - Head protection system,
 - Tanks,
 - Additional lighting: fog lamp, side marker...
- The objective is to provide to the car maker a fully equipped lateral off-line module.

■ ADVANTAGES

- Function integration and optimization (g. engine and wheel noise source treatment).
- Pedestrian protection.
- Assembly cost reduction.
- Headlamps and bumper/fender gap management.
- Diversity management.
- New styling opportunity.

■ INDUSTRIAL PROPERTY

- More than 5 patents from 1996 to 2003.

■ APPLICATIONS

- On-going expertise.



MODULAR STRATEGY

FENDER MODULE: FIXATIONS

■ DESCRIPTION

- Specific fixation systems have been developed for the thermoplastic fender so as to fulfill several functions like heat expansion during painting process, hood flushness, fusibility during impact and fender to bumper gap management. Two types of fixing have been developed, either for BIW fixation or for bumper/fender fixing.

■ ADVANTAGES

- Allow heat expansion during OEM's paint and e-coat steps without permanent distortion on fenders.
- No fender's damage during impact up to 15 kph.
- Easier hood gap positioning when hood is closed.
- Allow zero gap between the fender and the bumper.
- Simplify the bumper's fitting.
- Cost reduction due to the direct fitting between bumper and fender.

■ INDUSTRIAL PROPERTY

- 6 patents: sliding or fusible fixations, bumper/fender fixing, adjustable and head impact fixation.

■ APPLICATIONS

- Nissan TINO fender.
- Land Rover Freelander and Renault Clio 1 and 2 fenders (integrated fixation).



MODULAR STRATEGY

FENDER MODULE: HIGH HEAT THERMOPLASTIC MATERIAL FOR FENDER TO BE MOUNTED BEFORE E-COAT

■ DESCRIPTION

- A new high heat thermoplastic material has been validated to inject plastic fenders that can be mounted on-line (before e-coat) in OEM's body-in white plants. This material is a thermoplastic alloy (PA/PPE) manufactured by General Electric Plastics (GEP Noryl GTX 979) and withstand e-coat oven temperature of up to 200°C without deformation. This material allows to mount plastics fenders just like steel fenders keeping at the same time the well-known recognized advantages of plastic fenders.

■ ADVANTAGES

- Withstand e-coat temperature of 200°C.
- Weight saving (-1 Kg/fender compare to steel).
- Styling freedom.
- Small impact and dent resistance compare to steel (no damage at 15 kph).
- Injection process similar to previous GEP Noryl GTX grade.

■ APPLICATIONS

- On going expertise with European and US Oem's.



MODULAR STRATEGY

FENDER MODULE: ACOUSTIC WHEEL-ARCH

■ DESCRIPTION

- The wheel arch has a PP carpet overmoulded for wheel noise dampening. A 3 dB (A) noise reduction is reached (noise divided by 2) for rear passengers at 60 kph and 1000 Hz.

■ ADVANTAGES

- 3 dB (A) noise reduction
- Use of recyclable PP for over-moulding gives a fully recyclable part thanks to the use of a PP fabrics carpet.
- Easy, quick and cheap process (no welding, glueing...) by the use of overmoulding technology.

■ INDUSTRIAL PROPERTY

- Patent pending.

■ APPLICATIONS

- Rear wheel-arch.
- High range European vehicle (SOP mid 2004).
- On-going expertise on 2 other European high range vehicles.



PEDESTRIAN SAFETY - ACTIVE SYSTEMS

ACTIVE SYSTEMS FOR HEAD IMPACT

■ TARGET: PROTECTING HEAD WHEN NO PASSIVE SOLUTION POSSIBLE

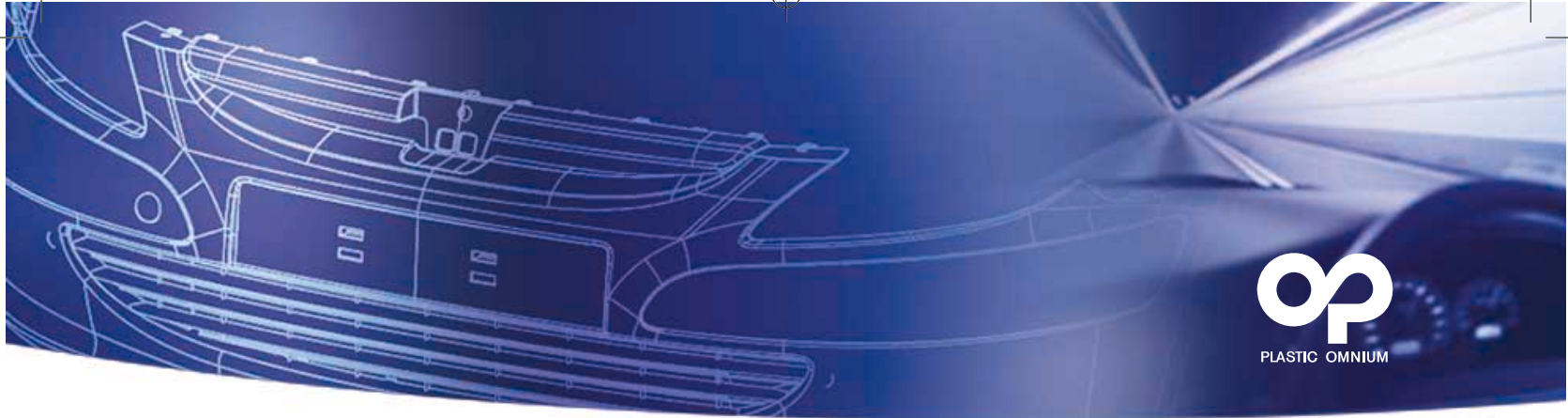
- Pedestrian detection:
 - very sensitive fire/no fire detection: Optic fibre, piezzo, accelerometer...
 - PO is testing solutions with different electronic suppliers.

■ LIFTING HOOD:

- to prevent the head to hit hard point under the hood.
- Short-term solution.

■ AIRBAG DEPLOYMENT:

- may become the solution if lifting hood is not efficient.
- Pre-study to integrate airbags in a fender module.



PEDESTRIAN SAFETY - PASSIVE SYSTEMS

UPPER TPO ABSORBER

■ DESCRIPTION

- PP injected ribbed box for pedestrian safety (lower leg) and parking impact.

■ ADVANTAGES

- Low cost solution.
- High efficiency and compressibility.
- Designed by FEM simulation with no prototype and Plastic Omnium commitment on functional results.
- «2-in-one»: lower leg treatment & ECE 42.
- Favourable to receive recycled material.

■ INDUSTRIAL PROPERTY

- Patent pending.

■ APPLICATIONS

- Expertise for small European vehicle.



PEDESTRIAN SAFETY - PASSIVE SYSTEMS

LOWER BEAM

■ DESCRIPTION

- Lower beam TPO injected controlling tibia rotation and absorbing part of insurance impact energy with ribbed absorbers.

■ ADVANTAGES

- 2 energy levels integrated in 1 part: lower leg impact at 40 kph and insurance test impact at 15 kph.
- Light (about 2 kg), low cost and recyclable part.
- Designed by FEM simulation with no prototype.
- Lower leg biomechanical criteria's respected, 3500 joules absorbed in 150 mm intrusion for the whole system.

■ INDUSTRIAL PROPERTY

- Patent pending.

■ APPLICATIONS

- Development on progress.



PEDESTRIAN SAFETY - PASSIVE SYSTEMS

REINFORCED UNDERTRAY

■ DESCRIPTION

- The undertray, already used as protective and aerodynamic element, has a new function due to its reinforcement: it protects the pedestrian by controlling the load on tibia and its rotation. Indeed, lower leg biomechanical criteria's are respected.

■ ADVANTAGES

- 3 functions in 1 part: pedestrian safety, aerodynamic and dust protection.
- Light (less than 3 kg), low cost and easily recyclable part (made in one shot by use of PP).
- Designed by FEM simulation with no prototype.

■ INDUSTRIAL PROPERTY

- Patented in France (1999), Europe pending.

■ APPLICATIONS

- On-going expertise on small European vehicle.



IMPACT ABSORPTION SYSTEMS

CLOSURES IMPACT PROTECTION MODULE A CLASS

■ DESCRIPTION

- Module for tailgate composed of A Class aspect body panel and a supporting structure fusible for 15 kph reparability specification (Insurance rating: Class 10).

■ ADVANTAGES

- Avoid tailgate damages at 15 kph resulting an insurance reduced cost.
- Zero gap and perfect flushness with steel tailgate panel over 1 meter length.
- Allow new styling option with flushness between the rear gate and bumper cover.
- Electronics device and antennas integration possible behind the non-conductive TP skin.

■ APPLICATIONS

- ROVER 75 Tourer (2000).
- RENAULT Mégane II (2202).



IMPACT ABSORPTION SYSTEMS

HTPC REAR BEAM

■ DESCRIPTION

- These composite impact beams are using pre-impregnated glass fibre fabrics and filled PP in order to reach high impact performances.
- A new injection technology have been developed in order to incorporate these glass fibre fabrics in a classical injection machine. The name of this technology is Hybrid Thermoplastic Composites (HTPC).

■ ADVANTAGES

- One-shot process (no assembly).
- Weight/performance ratio.
- Function integration.
- Beam can be saved after a first impact.

■ INDUSTRIAL PROPERTY

- 7 European and US patents (process & product) from 1994 to 2001.

■ APPLICATIONS

- GM 200 platform: Pontiac Montana, Oldsmobile Silhouette and Chevrolet Venture.



IMPACT ABSORPTION SYSTEMS

ONE PIECE TPO INJECTED REAR BEAM

■ DESCRIPTION

- Rear impact beam injected in non-filled PP meeting ECE 42 (4 kph) and insurance tests specification (15 kph)

■ ADVANTAGES

- Light (3 Kg) and cheap solution, recyclable.
- 4000 Joules absorbed with 130 mm intrusion at 15 kph for a 1.2 T vehicle. Efforts on rails: 5000 daN.
- ECE 42 European specification respected at 4 kph with a 50 mm intrusion.
- Function integration: step pad support, parking aid sensors fixation, bumper cover local stiffness.
- Proofed by FEM simulation before production tooling launch.

■ APPLICATIONS

- Development in progress.



IMPACT ABSORPTION SYSTEMS

2 SHELLS BUMPER BEAM

■ DESCRIPTION

- This beam can be used on the front or on the rear of the vehicle for energy absorption (ECE 42/4kph specification). It is injected in TPO non-filled material. It is made out of two parts clipped together to create a hollow section for higher inertia.

■ ADVANTAGES

- 100% thermoplastic, the beam is light (3 Kg).
- It is as well a cheap solution, recyclable at 100%. Recycled materials can also be used to make this beam according to mechanical performances required.
- This energy absorption system can be completely dimensioned by finite element modeling (FEM) saving the cost for a prototype mould.
- The intrusion at 4 kph is limited to 60 mm for a 1.35 T vehicle with low energy transmitted to vehicle structure.

■ INDUSTRIAL PROPERTY

- Patent pending in France.
- European patent pending.

■ APPLICATIONS

- PSA Peugeot Partner and Citroën Berlingo front beam.



IMPACT ABSORPTION SYSTEMS

UNDULATED INTEGRATED IMPACT ABSORBER

■ DESCRIPTION

- Those injected absorbers have undulated shapes which absorb energy in compression for impact between 4 and 15 Kph.
- This technology is available for front and rear impact management with a potential integration in the bumper cover.
- Denser ribs network can be designed in front of rails to absorb energy at 15 Kph (reparability impact test).

■ ADVANTAGES

- The geometry of these absorbers can be fitted to various energy absorption level.
- They are easier to inject and de-mould than classical ribbed box.
- The specific undulated shape has been optimized to avoid peak efforts allowing to economically replace expanded polypropylene (EPP) foam absorbers.
- Significant cost and investment saving can be realized when the absorber is integrated in the bumper cover (1 part and 1 injection tool saved).
- Partly or fully recycled material can be used according to required mechanical performances.

■ INDUSTRIAL PROPERTY

- Patented in France (FR 9804681).
- European patent pending.
- US patent: US 6315339.

■ APPLICATIONS

- Renault Kangoo II front bumper with integrated undulated absorber.
- Renault Kangoo II rear absorber with integrated step pad.
- Peugeot 307 front absorber.



ENHANCED FUNCTIONS

CAPACITIVE PROXIMITY SENSOR

■ DESCRIPTION

- This new type of proximity parking sensor is made of a film (thickness about 0,5 mm) placed into the rear and front bumper. Compared to the current ultra-sonic system, this sensor is totally invisible with no hole needed in the skin. As the sensor can't see through the conductive paint, it has to be placed behind molded in colour or overmoulded part.

■ ADVANTAGES

- Invisible assembly behind bumper skin or finisher strip.
- Avoid holes in the skin (compared to the current Ultra Sonic solution).
- Homogenous detection along bumper skin.
- Range of detection about 1,2 meter.
- Lightweight solution.
- Due to its thickness, no interference with the absorption beam.

■ INDUSTRIAL PROPERTY

- Patent pending.

■ APPLICATIONS

- On going expertise and test with European manufacturer on low range cars.



ENHANCED FUNCTIONS

SELF- DEPLOYABLE FRONT SPOILER

■ DESCRIPTION

- Front bumper module including a self-deployable spoiler. As the speed of the vehicle increases, aerodynamic pressure makes the spoiler go down automatically.

■ ADVANTAGES

- Aerodynamic performances improvement.
- Drag coefficient (CD) reduction/Fuel economy (4%).
- Lift forces (CL) increased on driving train: +70 daN (important for sporty vehicles).
- On-road qualities improvement: ground clearance at low speed.

■ INDUSTRIAL PROPERTY

- Patent pending.

■ APPLICATIONS

- On-going expertise on a European sporty vehicle.



VEHICLE DIFFERENTIATION

MOULDED IN COLOUR: METALLIC AND VIVID COLOURS

■ DESCRIPTION

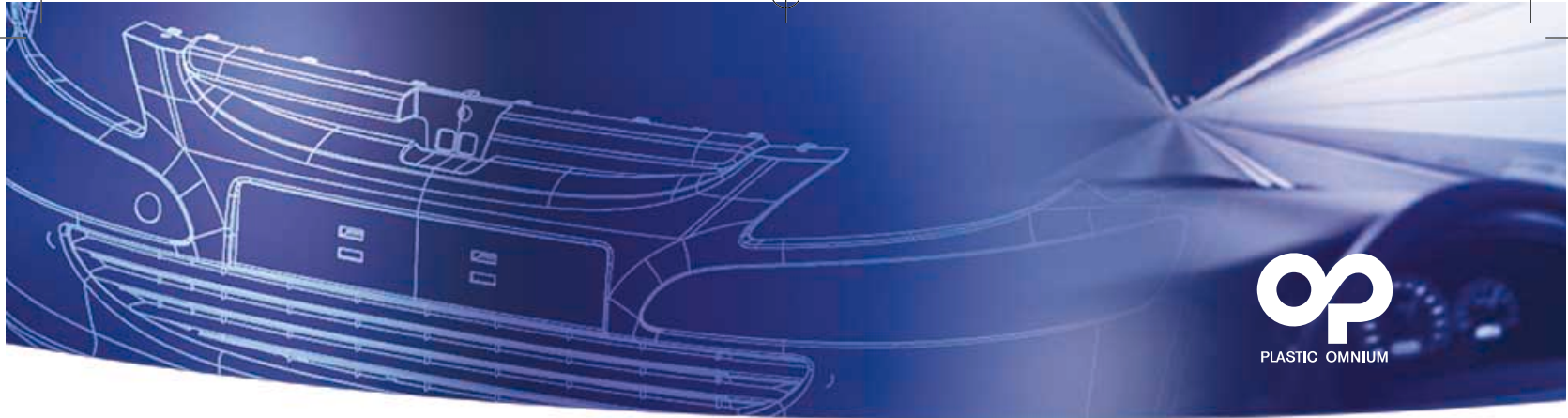
- PP + Master Batch including metallic, pearl flakes and new pigments systems offering vivid colour parts.
- Part design regarding the material.

■ ADVANTAGES

- Different aspects (metallic, pearly) through flake types (material, size, concentration) and colours.
- Plastic self signature at low cost.
- Part design and process controlled by Plastic Omnium.

■ APPLICATIONS

- Finishers (Tailgate, bumpers); wheel arch extension; bumper skins.



VEHICLE DIFFERENTIATION

OPALESCENT PP AND BACK DECORATION

■ DESCRIPTION

- This new type of decoration, already seen in the computer industry or in the household appliances, gives new aspect for exterior body parts by graining or painting opalescent material on the backside. The use of opalescent TPO or transparent resins enables to reach the automotive specification.

■ ADVANTAGES

- New unique translucent aspects.
- High depth of colours.
- Different effects: metal, interferential...
- Association with macro-texture possible.
- Low scratch damages.

■ INDUSTRIAL PROPERTY

- Patent pending.

■ APPLICATIONS

- Small parts such as bumper or tailgate finishers.
- Technology and Material: last validation end 2003.



VEHICLE DIFFERENTIATION

CHROME PLATING ON PP

■ DESCRIPTION

- A technology has been developed for chrome plating adapted to PP. This technology could be used on any part already proposed in ABS, such as bumper and tailgate finishers, air intake grilles, blades... and especially parts in impact area due to a very good low temperature impact.

■ ADVANTAGES

- Low temperature impact resistance better than ABS and ABS/PC: -10°C versus 23°C .
- Metallic aspect and touch with « cold » sensation.
- Easily recyclable: bumper skin and strip without dismantling (same substrate).
- Same aspect as on ABS.

■ APPLICATIONS

- Any part already proposed in ABS.
- Especially parts in impact area.
- All validations completed.



SUSTAINABLE GROWTH

DESIGN FOR RECYCLING AND DISMANTLING

■ DESCRIPTION

- Design and manufacturing of 100% recycled PP parts.
- 6 different recycled material sourcing, process for dismantling and moulding adapted.

■ ADVANTAGES

- Single TPO/PP base material.
- Dismantling time divided by 2 thanks to specific fixations and dismantling tools.
- Active involvement in eco-design program.

■ INDUSTRIAL PROPERTY

- First European application of Eco-design.
- Recycling know-how via Plastic Omnium Recycling division.

■ APPLICATIONS

- 4 Kg recycled material/vehicle on RENAULT Mégane II sourced on 5 different parts.
Over 4000 T/year of recycled material used.
- 3 other European vehicles in development.



SUSTAINABLE GROWTH

WATERBORNE PAINT DEVELOPMENT

■ DESCRIPTION

- Application of a waterborne paint system instead of solvent base in order to reduce volatile organic compound (VOC) in the atmosphere (Forthcoming regulation).

■ ADVANTAGES

- VOC decreasing.
- Marketing impact.
- Colormatching with waterborne painted Body in White by car makers.

■ APPLICATIONS

- New paint lines with waterborne basecoats or/and waterborne primer in development.