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INTERIOR SOFT TRIM MATERIALS AND PROCESSES MEET NEW CHALLENGES AND OPPORTUNITIES

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A deflationary global economic environment, intense competition between automakers and increased buying power by consolidated Tier 1 interior suppliers have eroded the profitability of Tier 1 interior parts and raw materials suppliers. Process technologies for manufacturing interior soft trim modules have evolved only slightly during the past five years. Current processes still have multiple steps, high labor content, and high scrap rates due to the complex, multi-material sandwich construction used in most interior modules. These automotive interior market dynamics are driving Tier 1 suppliers to seek cost savings via process innovation and further parts consolidation to simplify, reduce, and error-proof the manufacturing process.

During the same period, performance requirements have become more severe and the criteria have broadened, stimulating materials substitution and creating value-added opportunities. Some examples of the implications of these new requirements and the materials and process implications are given in the table.

Acoustic Performance -- of the auto interior has often been treated as an important but secondary characteristic to be managed at lowest cost, with minimal engineering input, often late in the design/production process. The floor/acoustics module and headliner are receiving renewed engineering emphasis due to:

- Increased drive-by noise reduction requirements in Europe,
- Recent interest in reduction of airborne noise to accommodate increased telematics content,
- Potential savings from modularization of components,
- Targeting cost savings for the floor/acoustics module via parts and sandwich consolidation.

The need for acoustic performance, combined with weight and cost savings has driven the development of light weight, cost effective modular solutions for these components from Rieter, Collins & Aikman, Johnson Controls, Lear, Huntsman Polyurethanes (acoustically tailored PU foams), Dow, Bayer, and Azdel. European acoustics module suppliers who must contend with noisier diesel engines, smaller vehicles, and weight reduction pressures due to higher fuel prices are somewhat ahead of their North American counterparts in the development of materials and process technology for cabin and trunk acoustics/floor modules, headliners, and dash mats. The higher rate of substitution of PU foam for regenerated cotton fiber-based acoustics pads in the European fleet is one example of this trend.

Floor Modules -- Versatile space management concepts for the floor module have led to semi-structural sandwich constructions based on lightweight rigid skin/EPP foam/textile laminates based on EPP from Fagerdala and JSPI and lightweight skins from Azdel, Inc. Initial penetration in German models has spread across the Atlantic to North America. Polyurethane-based sandwiches are also seeking this market. Value is created when these semi-structural laminates also offer acoustic properties and are made in high-speed continuous operations.

The Interior Environment -- Interior fogging levels have been significantly reduced after ten years of effort. Recent concerns, primarily initiated by German OEMs, have been with the zero-smell interior and more recently with driving volatile organic compounds (V.O.C.) levels in the interior down as close to zero as possible. In May, a working session organized by the German VDI examined the implications of targeting lower V.O.C. levels. As shown in the table, lower V.O.C. levels could have a significant impact on materials substitution choices offered by suppliers of PU foam, skins, and coatings.

ELV Legislation -- continues to stimulate the search for mono-materials sandwiches and easily recyclable constructions for interior modules. There has been no net reduction of PVC demand but rather due to increase due to PVC usage for glazing seals and coated fabrics.

Instrument Panel Skins -- The 1999 GM decision to seek alternatives to PVC in interiors continues to stimulate material substitution research by resin and roll goods suppliers for instrument panel and door trim skins. The major driving forces for the GM substitution directive were:

- low temperature performance (for high growth passenger invisible airbag doors; see chart)
- improved UV resistance
- easier recyclability (from mono-materials sandwich constructions)
- the potential for reduced fogging (not always realizable by PVC alternatives)

- harmonization of the materials selection palette between Europe and North America.

Thus far, the major interior substitutions have been in instrument panel skins where slush molded TPU, spray polyurethane (from Recticel), and thermoformed TPO have gained share at the expense of thermoformed PVC and slush molded PVC (see graphs for the European fleet). Thermoformed skins generally have lost market share to such non-thermoformed alternatives as sprayed PU and slush molded TPU. The charts show the decline of thermoformed skins in favor of slush and sprayed IP skins in the European fleet.

TPO skins have thus far not gained the major position expected in IPs due to their higher cost (vs. PVC thermoformed skins) and the difficulty of retaining grain definition during thermoforming when positive forming processes are used. This disadvantage for thermoformed TPO appears to be resolved through the use of negative thermoforming (introduced by Visteon and others in the North American and European fleets).

Coated Fabrics -- PVC coated fabrics are used as the surfacing for seat backs and sides as well as some minor applications such as security shades. Roll goods suppliers in the U.S. and Europe are actively seeking substitutes for the plasticized-PVC used in coated fabrics. The PVC substitution candidates that have emerged thus far are polyurethane and TPO coated fabrics. Polyurethane coated fabrics are considerably more expensive than PVC coatings and are targeted at the rapid growth leather trim market.

TPO coated fabrics at first encountered difficulties because they were:

- Too stiff (poor drape properties)
- Not weldable by RF techniques
- Too expensive compared to PVC.

Cost Reduction -- remains the major driver and has resulted in increases in modularization of interior components, sandwich and component consolidation, putting the acoustic functions "on-board" on the interior modules (rather than adding them later), and the evolution of more efficient, simplified processing steps.

Direct Compounding/Fabrication -- Tier 1s (notably Faurecia and JCI) have found that it is possible to compound and fabricate interior components in a single line rather than making or buying pellets from a compounder. Direct compounding/fabrication has been applied to parts (e.g., IP substrates) molded from long glass fiber reinforced polypropylene in which the ability to retain fiber length during compounding and molding is the key to property retention. It is possible that the direct compounding/fabrication processes will be extended to talc reinforced substrates if the cost savings prove viable.

In-mold Decoration and Molded-in Decoration -- Back-printed films (from Rexam, Avery Dennison, and others) are used as a decorative method for interiors. Recently, Coextruded films have been used in in-mold decoration processes as a paint substitute for bumper fascia. Coextruded multi-layer films may find a path into the interior as a paintless method for achieving soft touch and the recently stylish metallic look. Molded-in decoration (via a decorated layer in a multi-layer construction) for floor modules is feasible when non-carpet flooring surfaces are used as in several light commercial vehicles in the European fleet.

Robert Eller is president of Robert Eller Associates, Inc., a consulting firm providing analysis in support of management decision-making in the automotive plastics and rubber sectors. His company is preparing the second edition of a multiclient analysis of the technology, economics, and market dynamics of the automotive interior soft trim sector and a photo/supplier database of European instrument panels. His firm (homepage http://www.robertellerassoc.com) has offices in the U.S. (Akron, OH) and France. He can be reached at bobeller@prodigy.net.

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NEW PERFORMANCE REQUIREMENTS DRIVING MATERIALS AND PROCESS SUBSTITUTION IN EUROPEAN AUTO INTERIORS

REQUIREMENT/ TREND	ACTUAL OR POTENTIAL CHANGE	MATERIALS/PROCESS IMPLICATIONS AND EXAMPLES
ACOUSTIC PERFORMANCE	-REDUCED DRIVE-BY NOISE -REDUCED INTERIOR AIRBORNE NOISE	-'TUNED' ACOUSTICS/FLOOR MODULE -LIGHTER WEIGHT ACOUSTICS SYSTEMS
INTERIOR ENVIRONMENT	-NO-SMELL INTERIOR -REDUCED V.O.C. LEVELS	-LOW V.O.C. PU FOAMS, SKINS -NON OIL-MODIFIED TPEs -ELIMINATE OF HOT POUR PU FOAM SEATING -REDUCE COATINGS ON SKINS, SUBSTRATES -IN-MOLD DECORATIVE FILMS
OCCUPANT SAFETY	-U.S.-TYPE HEAD AND SIDE IMPACT REGULATIONS	-INCREASED USE OF ENERGY ABSORBING FOAMS
UTILITY FUNCTION/LOOK	-NON-CARPET FLOORING -INSTRUMENT PANEL SKINS -INVISIBLE AIRBAG DOORS	-TPO (TPU?) SHEET FLOOR/ACOUSTICS MODULE -ALL-POLYOLEFIN FLOOR MODULE? -TECHNICAL GRAIN IP SKINS
END OF LIFE	-ELV LEGISLATION	-MONOMATERIAL SANDWICHES -RECYCLATE CONTENT (NO COST INCREASE) -NATURAL FIBER COMPOSITES
COLOR MATCH	-COLOR MATCHED BODY/GLAZING SEALS	-TPE GROWTH IN BODY/GLAZING SEALS
SKINS GRAIN	-GRAIN RETENTION DURING FORMING	-INCREASED USE OF SLUSH, PU SPRAY -RIM-PU SKIN PROCESSES -NEGATIVE THERMOFORMING OF TPO SKINS
FLOOR SPACE MANAGEMENT	-SEMI-STRUCTURAL SANDWICHES	-AZDEL/FOAM/TEXTILE LAMINATES
LOW TEMP PERFORMANCE	-AIRBAG DEPLOYMENT WITHOUT SHARDS	-NON PVC GROWTH IN IP SKINS
PROCESS COST REDUCTION	-MODULARIZATION -PARTS CONSOLIDATION -SANDWICH CONSOLIDATION	-DIRECT COMPOUNDING/ FABRICATION -ON-BOARD ACOUSTIC BARRIERS -"POPULATED" PANELS -HARDWARE CASSETTES (E.G., DOOR MODULES) -ON-BOARD ENERGY ABSORBING FOAMS

SOURCE: ROBERT ELLER ASSOCIATES, INC., SOFT TRIM MULTICLIENT

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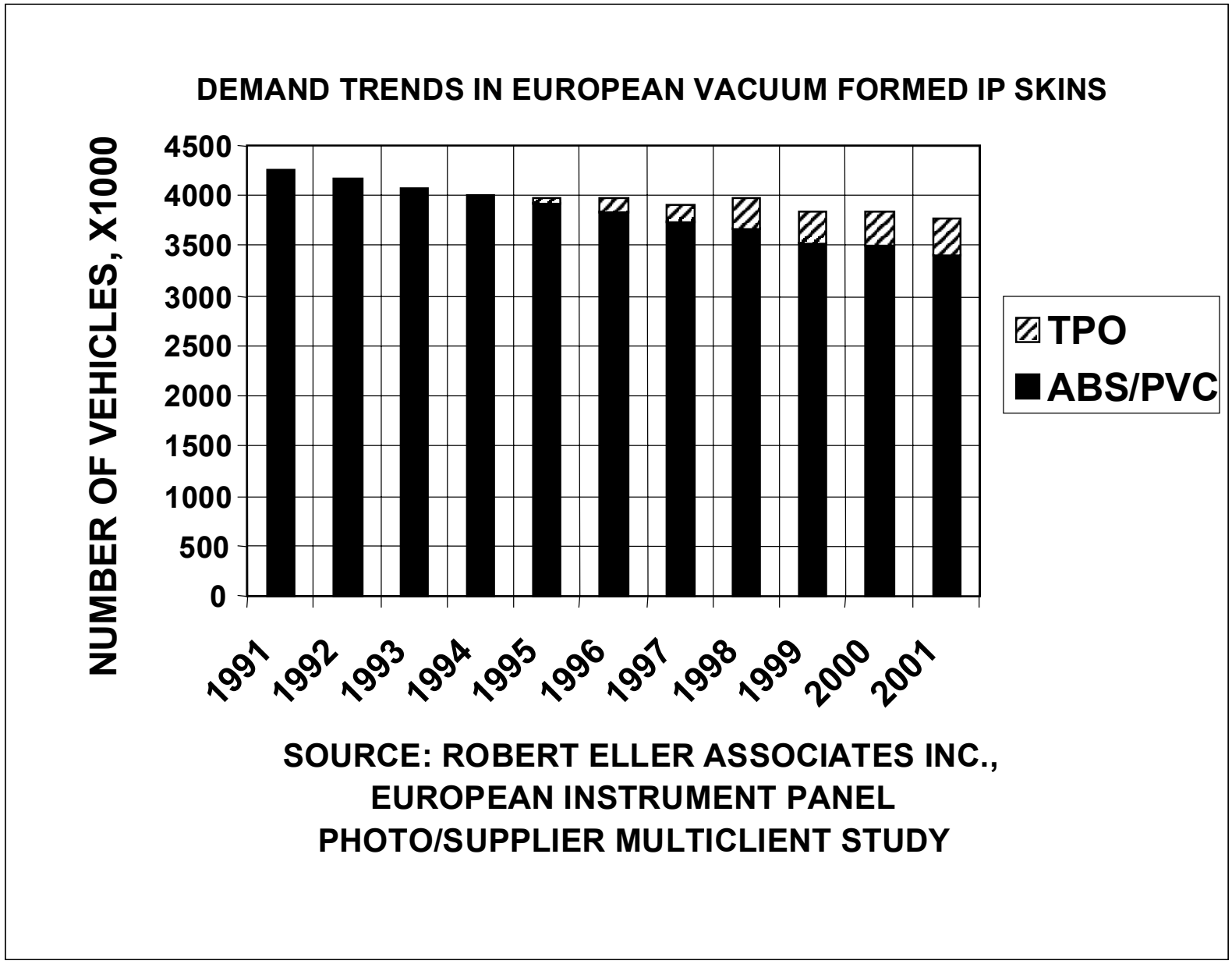
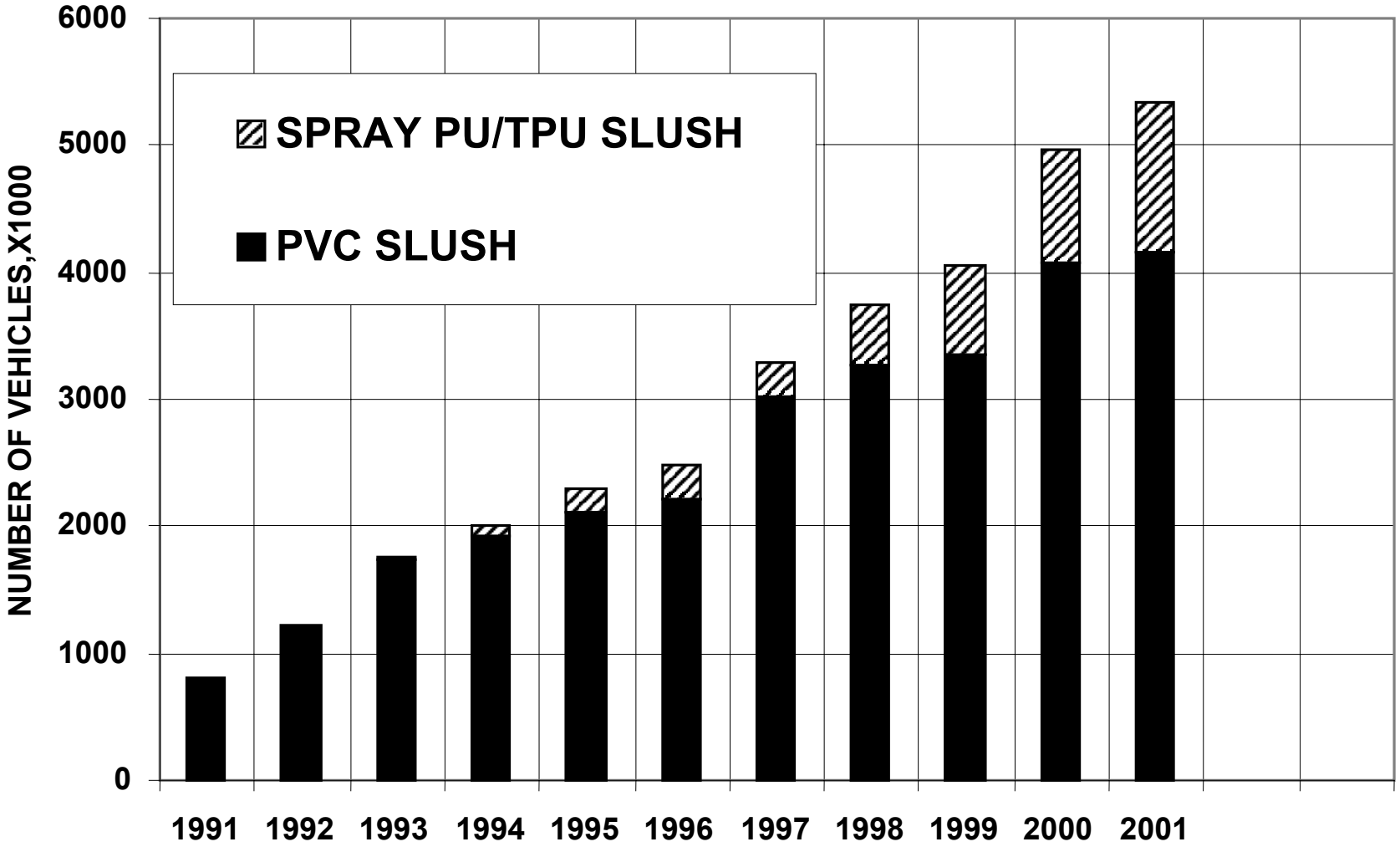
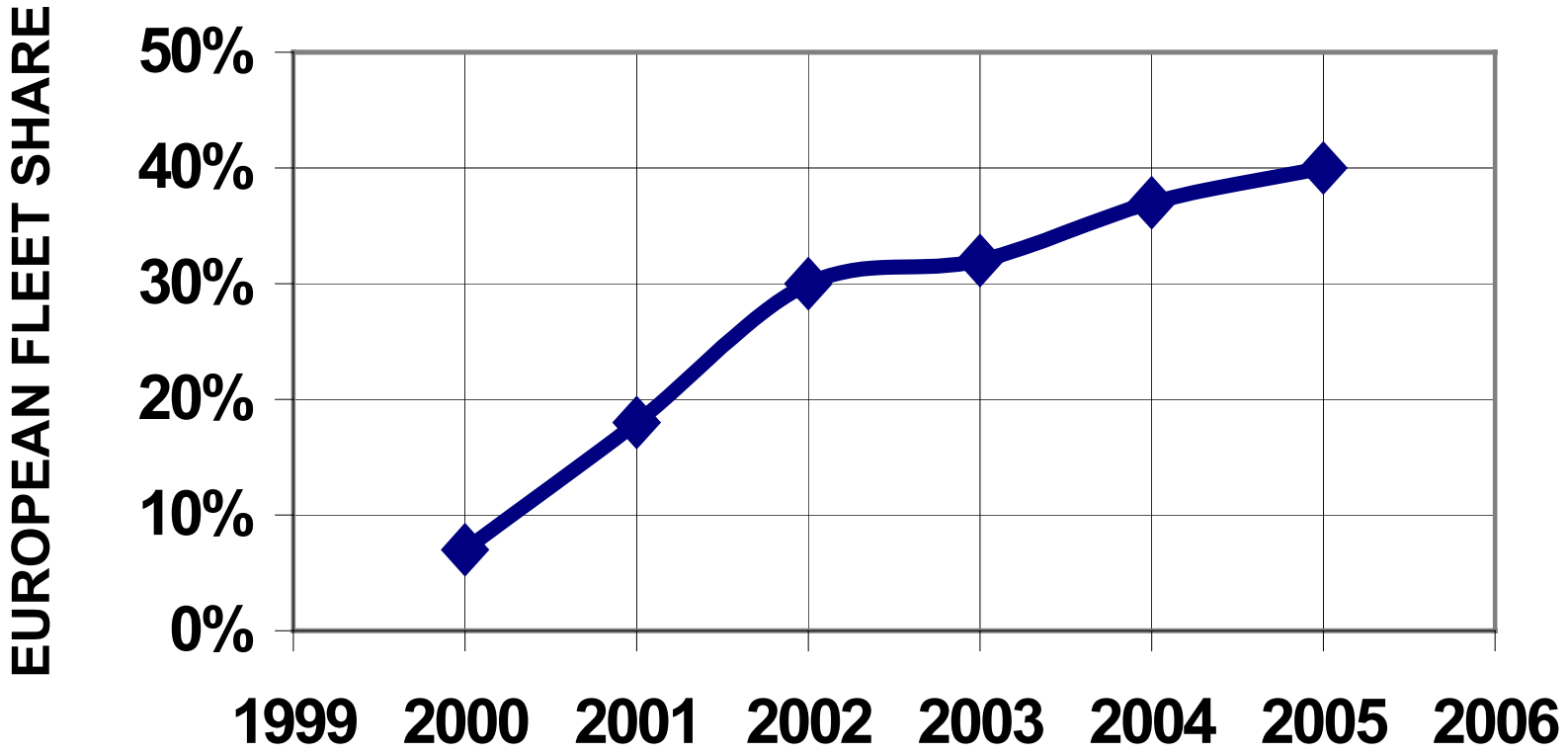

DEMAND TRENDS IN EUROPEAN VACUUM FORMED IP SKINS
NUMBER OF VEHICLES, X1000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
TPO
ABS/PVC
SOURCE: ROBERT ELLER ASSOCIATES INC.,
EUROPEAN INSTRUMENT PANEL
PHOTO/SUPPLIER MULTICLIENT STUDY

DEMAND TRENDS IN EUROPEAN SLUSH MOLDED IP SKINS



SOURCE: ROBERT ELLER ASSOCIATES INC.
EUROPEAN INSTRUMENT PANEL PHOTO/SUPPLIER MULTICLIENT STUDY

SHARE OF EUROPEAN FLEET WITH INVISIBLE AIRBAG DOORS



SOURCE: ROBERT ELLER ASSOCIATES EUROPEAN INSTRUMENT PANEL DATABASE