Windsor Industrial Development Laboratory, inc.

WIDL *Écho*

Your partner in design through simulation

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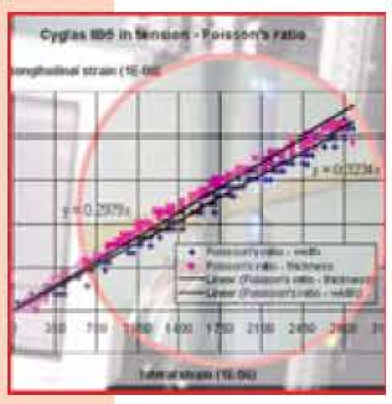
About Us

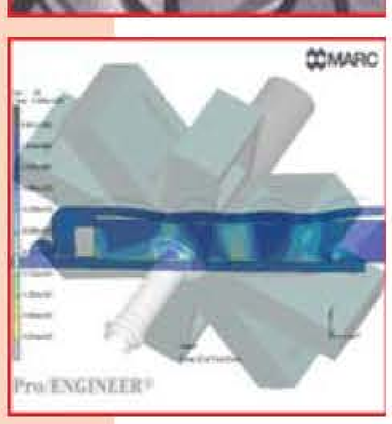
WIDL's continuous growth proves technical competence and responsiveness to clients' needs, and project management efficiency.

WIDL concentrates on materials, and design for manufacturing in special environments, and on technologically advanced machinery for demanding duties, both requiring specialized input. WIDL has years of experience that can be deployed to benefit your product or process, either on a project or a retainer basis.

Indeed, if you need an independent failure, wear, or corrosion analysis or testing, a materials research or project management resource, assistance with component or machine design, WIDL is the firm to team with. We can assist you develop goods, in-house, working with your engineers or designers, or off-site, using our own computing software and hardware, and laboratory machinery.

In fact, designs can be configured from specifications, or reverse engineered from existing hardware. WIDL can assist in both, from design reviews and technical interchange meetings, to finished products set for manufacturing, using a combination of laboratory tests and finite element models. Still, WIDL can assist you plan the work, and undertake materials selection and characterization, product and process simulation, prototyping, and validation testing. So contact us today, to learn more how we could well be "your partner in design through simulation"!





Compounding for End Use

Rubber on one hand consists of a complex formulation of cross-linked "base polymer", fillers (increasingly silica based), carbon black, and various other minor components such as cross linkers, gelatin accelerators, and ozone resistant chemicals, to name but a few.

On the other hand, the design space for most engineered rubber products calls for a range of performances to be met. For sure, rubber products have to withstand degradation in the environment during use. However, they need not cause disposal problems after having done so.

Now a question that often gets asked is: "**How to formulate a compound to make a product meet specific end requirements?**"

The answer to such question is multi-disciplinary. It involves input from the product end user, all the way to the chemist formulating rubber in the laboratory, passing by an analyst, a process engineer, a mold or die maker, a designer, and a machinery builder. The fortunate part is that such cross-functional team has been in place within the rubber industry. The unfortunate part is that the analyst has been missing until recently.

Indeed, the design of rubber products and the way to make them, have seen "trial and error". Fortunately, computer technology is rapidly becoming spread distributed, and sophisticated software are developing to render the traditional "trial and error" approach obsolete.

As so, a concept of a rubber product or mold, "drawn on a napkin", can quickly be transformed into a parametric solid model. A mesh can then supercede to enable the simulation of performance of product, or follow uncured rubber in processing equipment, in shaping the good.

In fact, the approach described (based on FEA, Finite Element Analysis, and CFD, Computational Fluid Dynamics) has been available at progressively more mature stages for 30 years. However, except for tires, its impact on rubber technology appears to have been delayed, because of experimental and numerical complexities (non-linearities in materials, contacts, and large deformations).

Design via FEA allows the determination of stresses and temperatures in a rubber component. If these are excessive, the product can be altered inside the computer, till meeting performance criteria. Similarly, CFD can support mold engineering by predicting flow of melt and shape changes occurring as rubber scorches and cures. These techniques are grouped under Computer Aided Manufacturing and Engineering, or CAM/CAE.

Still, two "roadblock" remain to answer the (chemist or sales person's) question raised earlier: (1) CAM and CAE software, and tests, like hardness, abrasion resistance, and tensile or tear strength are macroscopic in nature, yet (2) Laboratory experiments (stress strain curves, relaxation data, etc.) are input to predictive software. As so, one cannot really start from the requirements on a product to find the appropriate formulation for the application! The alternative is therefore to "close the loop" between materials testing and FEA/CFD, in what is known as "design iterations".

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Do you know?

that nondestructive tests are desirable for materials that are costly or difficult to fabricate, or that have been formed into finished or semi-finished products.

Liquids – One technique to locate surface cracks and flaws in metals uses a penetrating liquid, either brightly dyed or fluorescent. After being smeared on the surface of the material, the liquid is wiped off, leaving readily visible cracks and flaws. An analogous technique, applicable to non-metals, uses an electrically charged liquid to smear on surfaces of a material. After excess liquid is removed, a dry powder of opposite charge, sprayed on the material, gets attracted to cracks. Neither of these methods, however, can detect internal flaws.

Radiation – Internal and external flaws can be detected by "X" or "gamma" ray techniques, in which the radiation passes through the material and impinges on a suitable photographic film. Under some circumstances, it is possible to focus the X-rays to a particular plane within the material, permitting a three-dimensional description of the flaw geometry, and its location.

Sound – Ultrasonic inspection transmits sounds above the human hearing by a material. In the reflection technique, the wave is transmitted from one side of the sample, reflected off the far side, and returned to a receiver. Upon impinging on a flaw or crack in the material, the signal is reflected, and its traveling time altered. The actual delay becomes a measure of the flaw's location; a map of the material can be generated to illustrate the extent and shape of flaws. In the through-transmission method, the transmitter and receiver are located on opposite sides of the material.

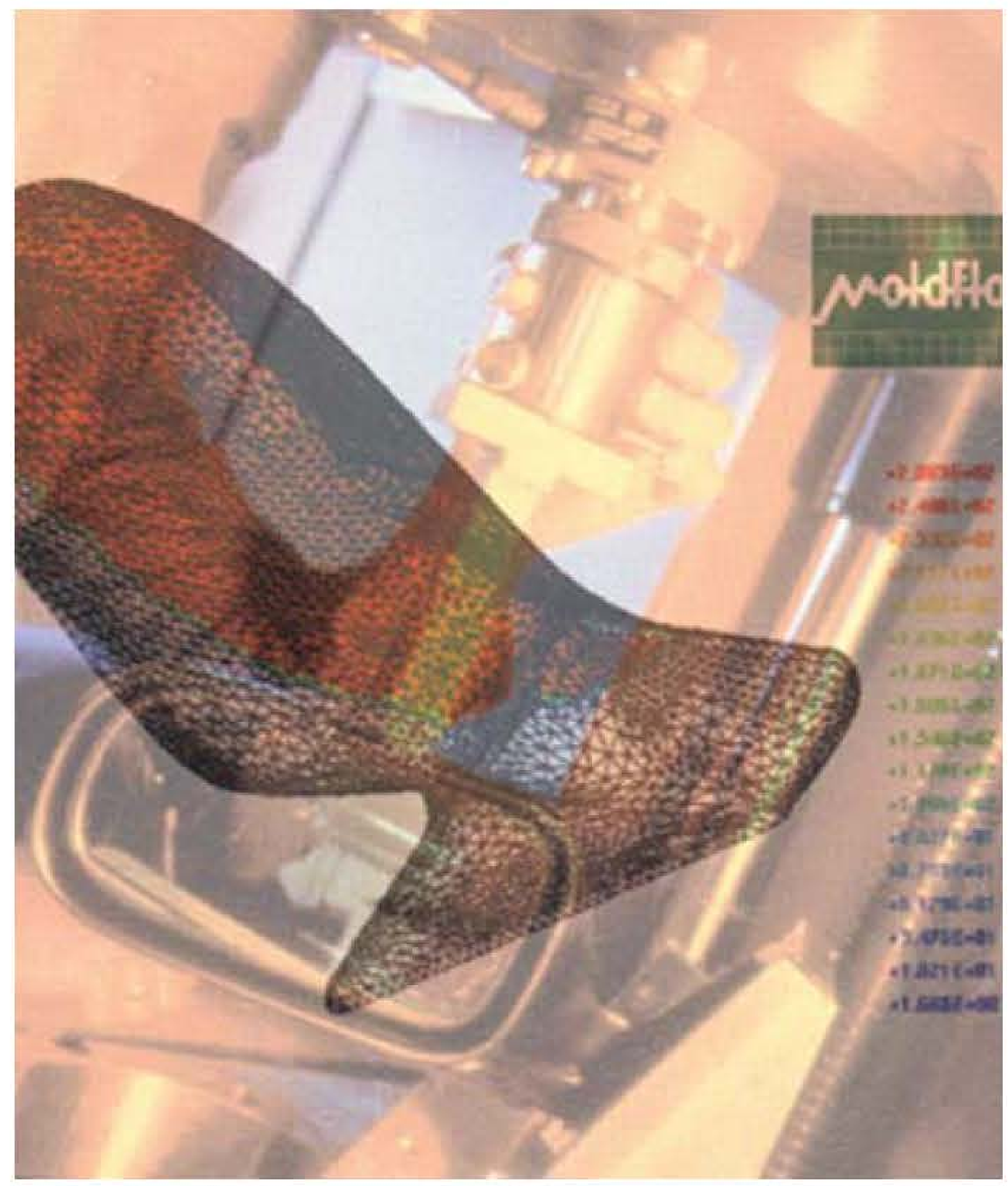
Magnetism – Magnetic techniques can "pin" and size voids and cracks. For magnetic testing, a large (primary) coil of wire with a steady alternating current is used, and nests a shorter (secondary) coil with an electrical measuring device. The steady current in the primary coil causes current to flow in the secondary coil, by induction. This method only detects differences between zones along a length of a bar, and cannot detect long or continuous defects very readily. An analogous technique, employing Eddy currents induced by a primary coil, can be used as well, to detect flaws and cracks.

Infrared – Infrared techniques have also been employed to detect material continuity in complex structural situations. In testing the quality of adhesive bonds in a sandwich material for example, heat is applied to the surface. Where bond lines are continuous, the core materials provide a heat sink for the surface. Where the bond line is inadequate, missing, or faulty, however, temperature will not fall. Infrared photography of the surface will then indicate the location and shape of the defective adhesive. A variation of this method employs thermal coatings that change color upon reaching a specific temperature.

Metals-to-Plastics Parts Conversions

Higher stiffness, excellent chemical resistance, better economics and improved performance offered by numerous reinforced grades provide several incentives to utilize plastics in numerous industrial applications. Plastics offer substantial cost savings over conventional materials, primarily due to design and fabrication advantages. Flexibility in processing brings a further reason to using plastics (post-production finishes, machining, and assembly).

However, replacing metal parts with more economical plastics ones should include expertise in pre-production design, prototyping, tooling, and manufacturing.



Testing Plastics and Simulating the Processing of Car Mirror at WIDL

Indeed, metals-to-plastics conversions require a far better understanding of the mechanical and chemical properties of resins, and their processing. Beside strength and modulus, other properties, such as creep, fatigue, and degradation in the surrounding environment are crucial. Thermal and mechanical compatibility with metallic components, such as inserts at bolt holes, is also necessary. Consideration of assembly, or molding operations (ultrasonic welding, clipping, inserts-molding, etc.), is a further necessity.

Combining properties of plastics and both product and process analyses yields economical productions. Early involvement of analyst, molder, resin supplier, mold maker, and machine builder, gives ample opportunity to enhance function, fit, assembly, performance, while reducing cost.

Product conversion to plastics couples materials characterization to CAD, CAM, and CAE. Testing materials, solid modeling, Numerical Control or NC machining, Finite Element Analysis or FEA, and Computational Fluid Dynamics or CFD, fuel the approach. Such early design by analysis approach not only saves time, it allows for changes far earlier in a program too, eliminating costly overruns. Moreover, design by analysis provides designers, manufacturing engineers, and toolmakers a great opportunity to apply their expertise on a common "virtual" database. Such database could reside by the manufacturing site. Alternatively, it could remain at a development house, for quick and professional access, if and when needed.

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