From simple to complex designs

Jacobsen Lenticular Tool & Cylinder Engraving Technologies Co. (JacoTech) provides the global plastics processing sector scientific solutions for the development and production of optically-based cylindrical polymer/plastic materials processing, including the manufacturing of micro-structured, optical-quality, roll-surface mold components used for the management and control of light. The focus of JacoTech's custom optical micro-machining business is the ultra-precision CNC diamond turning, milling, and fly-cutting of cylindrical drums, rolls, and mandrels used to extrude/emboss/cast or calendar plastic and polymer based sheet and roll films and materials. The engraved units, such as shown in Figure 1, can be relatively small to unusually large (1,060 mm outer diameter by 4,500 mm wide) and heavy weight (2300 kg). These optical-grade engraved cylinder processing moulds can contain simple to complex geometrical patterns designed to perform a number of complicated light management control functions.

Using its custom-designed, precision large-scaled diamond turning equipment, JacoTech engraves complex optical patterns into materials such as copper, aluminum, electrolytic and electroless nickel alloys, beryllium copper, brass, gold and more. Figure 2 illustrates a typical drum during the engraving process where the engraved portion is shown beyond the mirror-surfaced portion of the drum yet to be engraved. Representative engraving is shown in Figure 3 where the lands between the groves are razor sharp, although the size of the lands can be sized as desired by the client. Jaco Tech's diamond-machined geometries can include plane, spherical, parabolic, general aspheric, toroidal, hyperbolic, elliptical, and cylindrical shapes including angular and circular patterns.

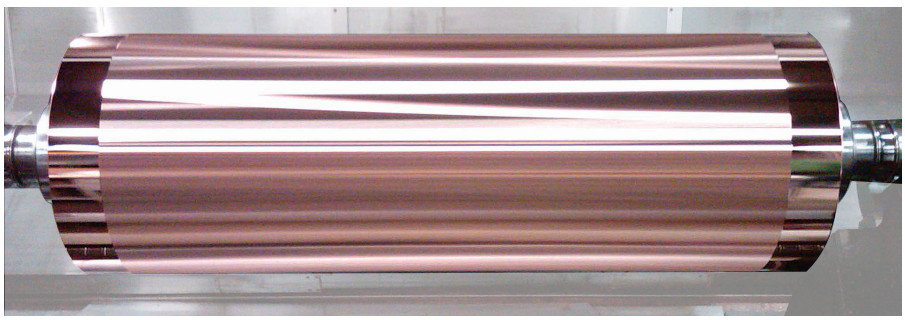

Fig. 1: The engraved units can be relatively small to unusually large and heavy weight.

Fig 2: A typical drum during the engraving process

"To obtain the best results from a well-manufactured, cylindrically-engraved mould, a proper optical lens design is required to enable optically-based sheet films and materials to perform optimally for a client's chosen resin and final end product," according to Dr. Gary A. Jacobsen, Chief Engineer and President. The company offers complete optical engineering and lens design services for lenticular lenses and other complex micro-structured plastic optical lenses, as well as lens system optimisation, diamond tool designing, and full metrology.

For over a decade, it has concentrated on improving the industry quality of both 3D-animated/motion lenticular offset printed and digitally-imaged display products used by lenticular specialty printers. "In order to accomplish this, an improvement over prior optical lens designs, diamond tooling and lenticular engraved cylinder mould processing were required to meet the ever-increasing requirements of world-class producers of extruded lenticular sheets. An example of such an improvement is JacoTech's ability to provide superior, ultra-low surface-waviness lenticular lens in its engraved cylinder moulds as compared to standard manufactured engraved cylinders," according to Dr. Jacobsen. A second example is customised shaping of the lenticular lens surface which creates much sharper, clearer, lower crosstalk, and greater apparent depth 3D-animated/motion lenticular printed/imaged products.

Unique engraving method

JacoTech also produces cylindrical moulds for non-imaging applications. Fabrication of these direct machined molds is intricate and time consuming. Figure 4 presents a photograph of a four-sided pyramidal structure (1.25 mm height) made by JacoTech. The plastic processing industry continues to seek improvement in lowering its manufacturing costs and improving profit margins for high-volume plastic/polymer produced products such as retroreflective vehicle license plates and road/traffic signage using three-sided corner-cube prismatic materials. "We created a unique method of direct engraving precision corner cubic pyramids into cylinders that can be used to create prismatic materials in web form at near full processing line speeds. The material manufacturing cost saving of using recent new advanced prismatic web roll production vs. prior art of costly and slow injection moulding and similar one-by-one piece production methods can be dramatically impressive," Dr. Jacobsen explained.

JacoTech's products are highly competitive and arguably set the quality and performance standard for these types of moulds. Such highly specialised custom engraved cylinders require essentially defect-free engraving in materials that yield a long life cycle. The cost of the mould is not the dominate cost element for its customers when compared to the entire processing cost that occurs downstream in the plastic processors facilities.

For over a decade, Dr. Jacobsen and his world-renowned optical colleague, Dr. R. Barry Johnson, have worked closely with a variety of technology experts to elevate the myriad of manufacturing and processing technologies necessary to achieve the finest quality engraved cylindrical drums in the world. This includes new diamond tooling shapes and structures, clever new hybrid CNC diamond turning techniques, and creation of JacoTech's own specifications for optical based copper and nickel/alloy plating to enhance achievement of the

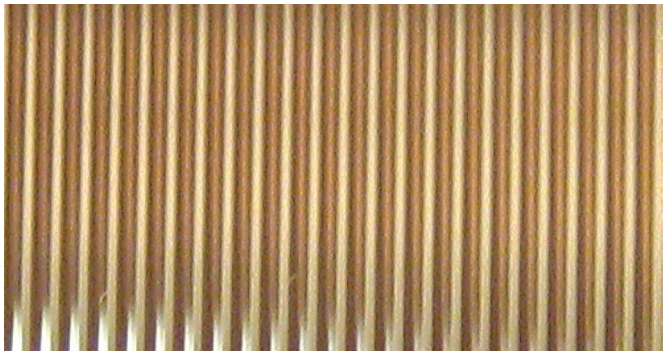

Fig. 3: Representative engraving where the lands between the groves are razor sharp, although the sizes can be determined by the client.

critical precision necessary for engraved patterns. JacoTech ships custom optically-based engraved cylinders around the globe for application in many different industries. These significant efforts and investments have resulted in the achievement of world-class quality and market acceptance by companies throughout the world.

For competition reasons and to gain more market share, JacoTech customers seek to offer their plastic processed sheet and roll products to their end customers at the best possible price. In today's environment, clients pay close attention to the dynamic changes in raw resin prices, and often then the lenticular extruders ask JacoTech for new optical lens designs and engraved cylinders for process modification.

JacoTech's manufacturing facility is located in the suburban Chicago, Illinois area. The facility is a secured closed shop do to highly specialised and confidential projects for various corporate accounts.

Drive towards value-added services

In order to offer "value-added services to our customers", the company continually pushes the envelope to the limits of technology and pattern designs with its own internal testing with live production utilising small-scale JacoTech test cylinders. This continual R&D development enables the company to keep up with the ever changing demands of international standards compliance for optical-based light management matters.

JacoTech is both scientific and customer driven. In order to remain important and offer value-added services to its customers, the company continually seeks to develop new micro-machining patterns and light management designs to positively enhance customer's plastic processing business. JacoTech is not simply an engraved cylinder mould supplier, but a leader in creative advanced development with receptive ears to its customers' needs, thereby building together a mutual partnership in contrast to the typical supplier-customer relationship. For more information about the company, visit: *www.JacoTech.com.* **IRNEA**

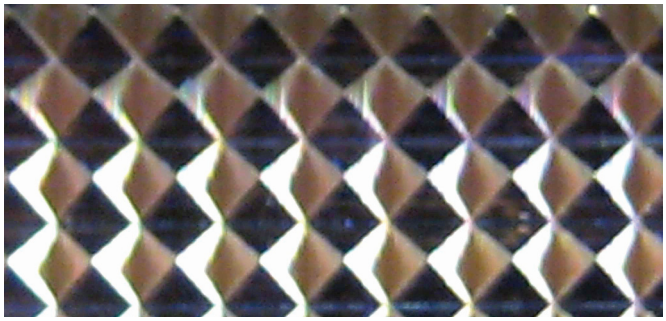

Fig. 4: A four-sided pyramidal structure (1.25 mm height) made by JacoTech

Technology Update

Precision strain hardening test method

A new method for high-speed evaluation of the slow crack growth resistance of high density polyethylene (HDPE) used for pressure pipes has been developed by Saudi Basic Industries Corporation (SABIC). The method will enable processors to benefit more quickly from new developments in general in HDPE for pipes, by cutting the time taken to bring a new material from the laboratory to the market. With the widespread acceptance of its Strain Hardening Test Method, SABIC hopes to accelerate adoption of its latest Vestolen A RELY grades of bimodal HDPE for high pressure pipe.

The Strain Hardening Method is faster and more cost-efficient than traditional methods of obtaining data on long-term performance in pipes. In addition, it requires neither a special notched specimen nor detergents. It is also easy to implement in laboratories, is suitable in the development of new grades by researchers, and also very valuable as a batch release test for resin suppliers, thus saving time, money and energy.

The international quality authority Kiwa Technology, based in Apeldoorn, The Netherlands, has already adopted the method which it said delivers reproducible results which very nicely correlate with results of time-consuming traditional slow crack growth tests - but in a much shorter time. Kiwa uses the test method to quickly provide pipeline owners with relevant information about the long-term quality of their existing polyethylene gas and water distribution networks.

Traditional methods for assessing long-term behaviour in pressure pipes like the Full Notch Creep Test (FNCT) and Notched Pipe test are measured in months and sometimes years. The tests are costly, and their reliability is uncertain. Using traditional notch tests, it would take many months to prove that a new material meets, for example, the highly-demanding requirements of PAS 1075. The Strain Hardening Method allows that time to be slashed to a few hours, requiring a simple tensile test at 80°C. Further advantages of this test method are very low measurement variation, absence of surfactants and notches, and the small amount of required testing material (< 50 g).

In recent years, an increasing number of countries in Europe have begun adopting even tougher requirements for pressure pipe, as laid down in the PAS 1075, a so-called Publicly Accessible Standard. This requires even higher resistance to slow crack growth (SCG) than is called for in the PE 100 specification. The move comes as a result of the increased use of new trenchless pipe installation methods such as guided boring and horizontal directional drilling; these methods have a very positive impact on the environment, but they pose higher demand on pipe properties, due to potentially higher surface damage which can ultimately lead to prior pipe deterioration. **IRNEA**