Add Light. It Will Cure.
Form-in-Place, Cure-in-Place Gasket

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DYMAX®

Light-cure gasketing materials increase productivity and cut costs on the production line by reducing the waste of traditional two-part, slow-cure urethane, thermally-cured adhesives, UV silicones, air-dry silicones, pre-form gaskets, or even hot melts.

Development of Light-Curing Adhesives

Light-curing elastomers have been developed for Form-In-Place (FIP), Cure-In-Place (CIP) gasketing applications. A 0.25" inch thick bead (of adhesive or material) completely cures in seconds upon exposure to light eliminating racking, stacking, and lost production time due to the long wait time for cure needed for slow-cure alternatives. Components sealed with UV FIP materials are immediately available for the next phase of the assembly process. This instant speed of cure is a drop-in replacement for preformed gaskets. The form-in-place, cure-in-place UV gasket is immediately ready for assembly or testing.

Light-curing materials (LCM) have been used in automotive, appliance, aerospace, medical device, and electronic manufacturing for more than 20 years. If light can reach the resin and the cured resin meets the application performance requirements, then the instant cure feature leads to a success for your assembly process. FIP/CIP gasketing is the latest utilization of the LCM technology advantage.

Comparison of UV to Competitive Products

Speed of cure for the UV elastomers is compared to traditional form-in-place gasketing materials (Table 1).

As shown in Table 1, UV acrylate is the fastest way to produce a FIP/CIP gasket. Material cost and

Table 1. Comparison of Cure Times of FIP Gasket Materials

FIP Gasket Chemistry	Time to Skin Over	Time to Full Cure Under Ambient Conditions
UV Acrylate	Seconds	Seconds
Air-Dry Silicone	Minutes to Hours	Hours to Days
2-Part Urethane	Minutes to Hours	Hours to Days
UV Silicone	Seconds	Hours to Days
Hot Melts	Seconds	Minutes

performance of traditional silicones and urethanes have been most commonly used for gasketing applications. Unfortunately, these two materials (silicones and urethanes) cure very slowly which add to the total cost of a manufacturing process. The inability to assemble the components, inspect the assembly, or perform quality control testing until the gasket is fully cured, adds further expense. Should the component be touched prior to full cure, the gasket will be permanently deformed resulting in a defective assembly.

Aside from slowing the process, silicones can release corrosive by-products during cure that can affect product durability of electrical circuits. The two-part urethanes present manufacturing issues because they are moisture sensitive, require exacting ratios, and air-free mixing. UV silicones also present assembly issues due to the amount of time needed for the bead of material to fully cure. This chemistry cures quickly on the surface but full depth of cure is not achieved without additional heat or moisture cure mechanisms. Hot melts cure quickly but require a significant capital investment and are not practical for small-volume applications or any thermal applications.

UV FIP Benefits

The UV form-in-place, cure-in-place gaskets are one-component chemistry with the advantage of instant cure. You just add light, it is cured, and your assembly is ready for the next phase of the process. These products are made from several different acrylated chemistries, including urethanes and rubber elastomers. While material costs compared to other liquid gaskets are slightly higher, the instant-cure UV elastomers offer dramatic reductions in processing costs.

The UV form-in-place, cure-in-place gasket process can be completely automated, including the dispense and cure of the bead. The potential benefits include:

- Significant reduction in labor costs
- In-line assembly and inspection
- Flexibility of product design (apply gasket to either side of the mating component surfaces)
- Reduction or elimination of specialized fixtures and jigs
- Elimination of customized and costly packaging designed to protect the slower curing gasket from being compressed permanently during handling and/or transportation.
- Immediate inspection of gasket compression and placement (and removal from component should a process correction be needed)
- Reduction or elimination of scrap
- Free up valuable plant floor space for new revenue streams (no need for racking assemblies while the gasket cures)
- Reduction in inventory – faster throughput
- Shortening Just-In-Time (JIT) manufacturing and shipping cycles

All of these benefits contribute to smoother, more efficient nd faster manufacturing, resulting in a positive impact on the bottom line. Figure 1 demonstrates the typical cost benefits of UV gasketing versus other FIP chemistries.

Material Costs

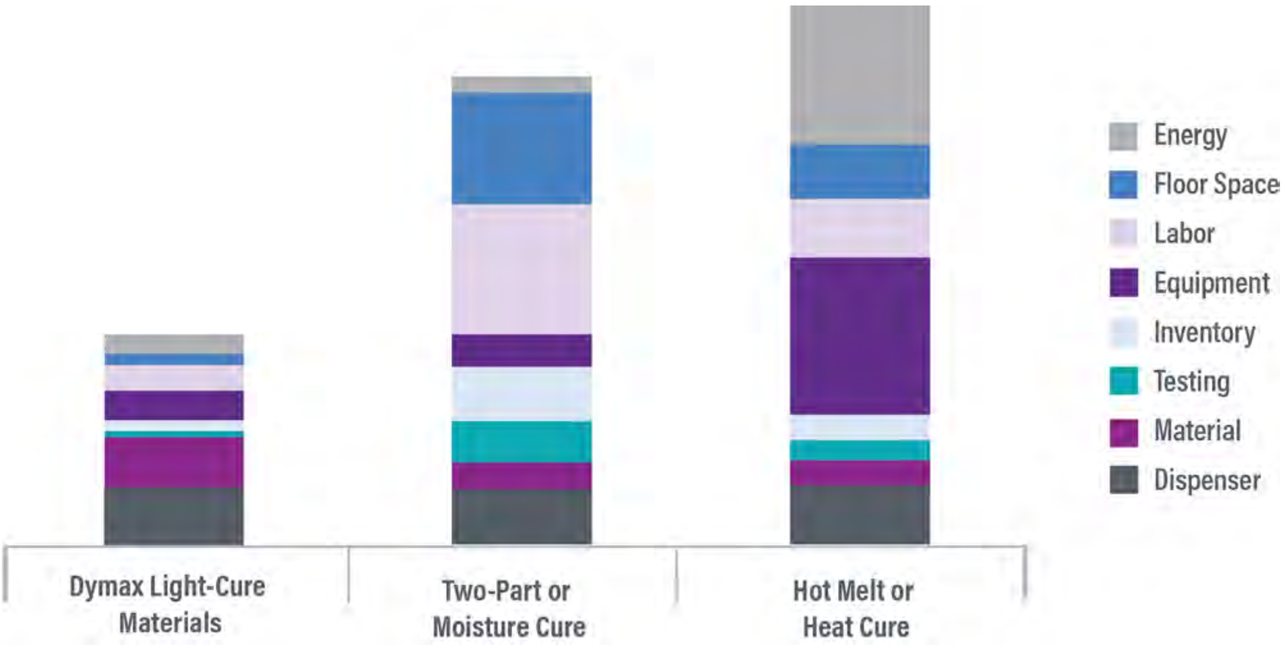
While the material cost for Light Curing Material (LCM) FIP gasket resins may be more than other chemistries, the overall cost of a LCM process can be significantly lower. Differing specific gravity and performance characteristics often mean less LCM material is required. Process costs are always reduced.

Dispense and Equipment Costs

A form-in-place, cure-in-place gasketing resin in a production assembly environment allows the use of readily available precision dispensing systems to achieve repeatable, consistent application results. Dispensing costs vary depending on the complexity of the dispense system. Systems are available ranging from simple operator controlled devices to complex 4-axis automated designs. The single component nature of LCM's reduce the cost, complexity and maintenance problems of two-part or hot melt systems used for other gasketing materials.

Light curing equipment is relatively inexpensive and is a one time setup cost. The additional cost for curing equipment is less than the cost of unproductive floor space, the cost of in-process part racking, or the energy cost for heat cure and other chemistries.

Figure 1. Relative Manufacturing Costs of Three FIP Methods



Testing Costs

The new FIP UV resins are dispensed as 100% solids which become solid polymer or plastic upon exposure to light. The ability to QC assemblies instantaneously allows manufacturers to avoid costly waste due to unexpected variations in two-component mixing, deviations in dispensing systems, or unexpected deviations in part tolerance. Being able to instantly QC means not having to scrap or rework an entire day's production or having to retrieve in-process parts that were shipped to a customer and expected to cure in transit.

Since no cure occurs before exposure to the light, there is additional benefit that any error or mistake in the dispensing process can be detected and corrected by the removal of the uncured resin.

Inventory Costs

Excess inventory is greatly reduced with the incorporation of a UV light-curing process. The value of the inventory is the sum of the material value of every component in the device, the labor required to assemble the components, and the energy consumed in manufacturing the assembly to the FIP stage. Any reduction in inventory costs associated with the completed component will help a company's bottom line.

Labor Costs

Historically, UV applications require less labor than other FIP technologies. LCM form-in-place, cure-in-place gasket application eliminates production steps such as the labor associated with part shuffling. UV FIP resin applications are easy to automate and have a much smaller footprint than other operations. The smaller footprint often allows one person to easily load and unload parts while keeping the process running to meet JIT and lean manufacturing requirements. This technology supports the streamlined manufacturing approach many companies are looking to incorporate to improve their productivity and increase profits.

Floor Space Costs

Floor space is valuable real estate in a manufacturing facility and a costly expense. The footprints for UV processes are smaller than other technologies. Consequently, UV processes can expand available production space. The costs associated with floor space include rent and mortgage, as well as maintenance and energy consumption (heating, cooling, and lighting).

The slow-cure FIP technologies require more floor space than UV processes. A UV process that includes dispensing, curing, and assembling can easily be dropped into a production line in a space as little as 2′ by 6′. High-volume applications may require more space, increasing the cure area from 2′ up to 6′. High-volume applications may also need storage space for the resins.

The speed of cure of the UV form-in-place, cure-in-place gasket allows conveyor speeds of 1 to 27 ft/min on conveyors fitted with moderate (200 mW/cm^2) to high intensity (2,000 mW/cm^2) UV lamps. These cure rates support the needs of high production volumes.

The instant cure of UV form-in-place, cure-in-place gasket processes can increase the value of how many dollars of product, per square foot of floor space, can be produced.

Range of New Properties for UV FIP Products

There are a wide range of different product profiles available for the light-curing form-in-place, cure-in-place gasket resins to support the assembly needs of the appliance, aerospace, automotive, electronic, and medical device industries.

Compression set is important for resealable and field-serviceable gaskets. The thermal range of these products is comparable to traditional urethanes and superior to most hot melts.

The UV FIP gaskets have adhesion to a wide variety of plastic and metal substrates. These cured resins provide excellent moisture and solvent resistance. The gaskets can be smooth for resealable applications or tacky for better sealing.

These new gaskets are ideal for applications requiring sound dampening or vibration dampening. For example, the FIP resins can be used to isolate speaker cone vibrations from the speaker cabinet and to quiet machinery.

Summary

With the global economy struggling and companies around the world looking to save costs wherever possible, optimizing your manufacturing assembly process and minimizing your material consumption may be a way to save some of those operating expenses. Light Curing form-in-place, cure-in-place gasket resins offer many production- associated savings and process and design advantages over traditional FIP gaskets. ***Dispense a bead, add light, and you are ready to go!***

Table 2. Typical FIP Gaskets Properties

UV FIP Characteristic	Characteristic Range
Viscosity	Self-leveling, thin-wicking grades (500 cP) to Thixotropic non-flowing gels (30,000 to 150,000 cP)
Durometer	Shore hardness 00 for high deflection to A60 for high-temperature sealing
Compression Set*	5% to 25%
Thermal Range	-55°C to 200° C [-65°F to 400°F]

* Compression set is the rebound from a 25% deflection after 16 hours at 70°C.

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