

### *Metallic Monomers for MMA Polymer Concrete*

#### **Introduction**

Metallic monomers are multifunctional acrylates that function as reactive fillers in methyl methacrylate (MMA) based polymer concrete. Two products are offered by Resin Solutions, Dymalink® 705 and Dymalink® 636. They are used as additives to increase the physical strength and adhesive characteristics of the polymer concrete. They can be used with either wet or dry aggregate, and are particularly effective when the aggregate contains up to 0.5% moisture.

**Formulating with Metallic Monomers** Dymalink® 705 and Dymalink® 636 are stable, free-flowing powders. They are insoluble in MMA monomer and should be treated like fillers and other solid ingredients when preparing the polymer concrete. Since they are reactive monomers, they will polymerize in the presence of peroxides and other free radical curatives. Thus, they should be mixed into the MMA monomer/aggregate component prior to adding the curatives and promoters. The recommended use level is between 2.5 and 15 percent based on the MMA monomer content. A starting point formulation is shown in Table 1.

**Table 1**

<u>Material</u>	<b>Formulation</b>	<u>Parts (Wt.%)</u>
MMA Monomer		13.1
SR350 Monomer		0.7
All Purpose Sand		86.2
Following Based on Monomers:		
Metallic Monomers		2.5-15.0
Dimethyl Para-toluidine		0.18
Dibenzoyl Peroxide (40%)		5.0

#### **Cure Characteristics**

The data in Table 2 show the effect of Dymalink® 705 and Dymalink® 636 on the workability, working time and curing time of a MMA polymer concrete that was prepared according to the formulation in Table 1. Dymalink® 705 and Dymalink® 636 have no significant effect on workability when compared to the control without the additives. However Dymalink® 705 does act as a retarder, extending both the working time and the curing time. Dymalink® 636 has no effect on the working time or the curing time relative to the control.

**Table 2**

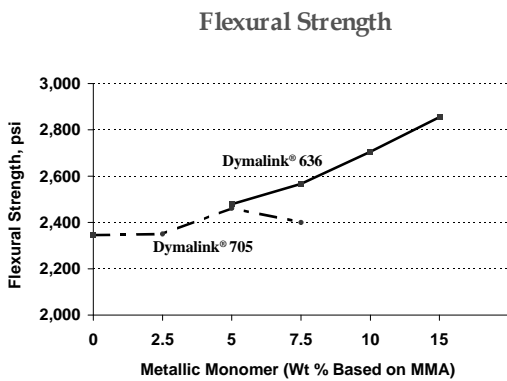
#### **Cure Characteristics**

	<u>Control</u>	<u>Dymalink®705</u>	<u>Dymalink® 636</u>
Workability (Flow,%)	194	194	194
Work Time (Min)	40	53	40
Cure Time (Min)	62	90	62

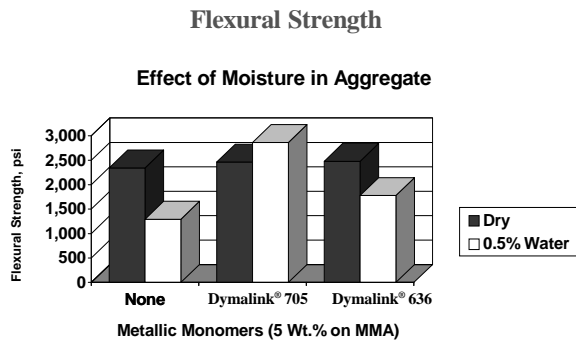
#### **Flexural Strength**

Figure 1 shows that the flexural strength of MMA polymer concrete increases with an incremental increase of either Dymalink® 705 or Dymalink® 636 when mixed with dry aggregate. With wet aggregate, however, the difference is much more dramatic. For example, as shown in Figure 2, with aggregate containing 0.5% water, an increase of 120% and 38% was obtained with Dymalink® 705 and Dymalink® 636, respectively. This was achieved with a metallic monomer concentration of only 5 wt.% based on the MMA content, which corresponds to only 0.7 wt.% of the total concrete formulation.

**Figure 1**



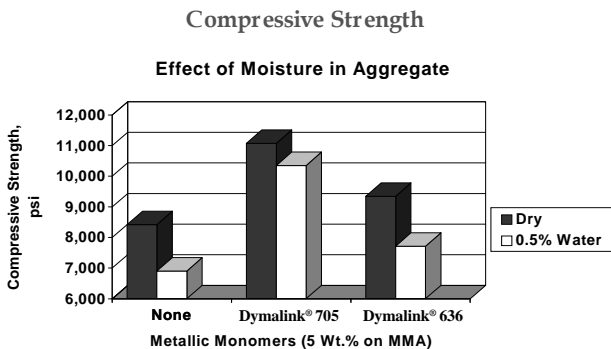
**Figure 2**



**Compressive Strength**

Dymalink® 705 and Dymalink® 636 also increase the compressive strength of MMA polymer concrete. As noted above, the metallic monomers are also effective when the aggregate contains up to 0.5% water. This is illustrated in Figure 3 for Dymalink® 705 and Dymalink® 636 at a concentration of 5% based on the MMA monomer component.

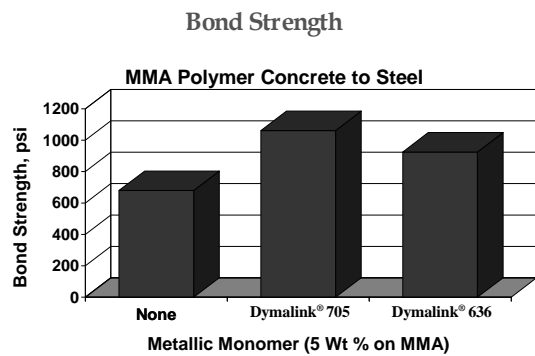
**Figure 3**



**Adhesion**

Metallic monomers are noted for increasing adhesion to metal substrates. Figure 4 shows the effect of Dymalink® 705 and Dymalink® 636 on the bond strength between MMA polymer concrete and steel. Both products increase the bond strength relative to the control without an additive. After aging 14 days at room temperature, Dymalink® 705 was particularly effective, giving a 55 percent increase over the control.

**Figure 4**



**Conclusion**

Dymalink® 705 and Dymalink® 636 are reactive fillers that can be used at low concentrations to increase the strength and adhesive properties of MMA polymer concrete. They are particularly effective when the aggregate contains up to 0.5% water. They are stable, free-flowing powders that have no adverse effect on the workability of the polymer concrete. Although they are not soluble in MMA monomer, they do react with the peroxide curative to become part of the cured polymer concrete.

## **About Resin Solutions**

Resin Solutions is the premier global supplier of specialty chemical additives, hydrocarbon specialty chemical, and liquid and powder tackifying resins used as ingredients in adhesives, rubbers, polymers, coatings and other materials. Resin Solutions has pioneered the development of these advanced technologies, introducing products that enhance the performance of products in energy, printing, packaging, construction, tire manufacture, electronics, and other demanding applications.

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