

**Improved Mold Release
with Zinc Stearate**

Description:

Cray Valley Company offers a variety of metallic coagents for peroxide curing elastomers. SR633 is zinc diacrylate, SR634 is zinc dimethacrylate, SR709 is zinc monomethacrylate and SR636 is calcium diacrylate. These coagents offer improved mechanical properties in the cured elastomers, such as tensile strength, tear resistance, higher elongation and improved rubber to metal adhesion.

It is this improved rubber to metal adhesion that causes problems with mold sticking for applications not requiring good adhesion.

It has been found that formulations can be modified with zinc stearate to reduce mold sticking without adversely affecting physical properties. External mold release spray systems can still be used in conjunction with the internal zinc stearate mold release agent.

Advantages:

- Tailor Zinc Stearate to Coagent Concentration
- No Loss in Properties for EPDM
- Use with External Release Agents
- Low Cost
- Works in Most Elastomers
- Reduces Mooney Viscosity
- Non Blooming
- Replace Other Fillers with Zinc Stearate

Mold Release Measurements

Mold release was measured by two methods. Lap shear adhesion (ASTM D816-55) to cold rolled steel was used as a laboratory test to quantify the adhesion characteristic of the varying zinc stearate concentration. This measurement was checked against the subjective mold release of the 75 mil plaque mold. In all cases, the two methods correlated making it possible to graph the release data.

Formulation Properties: EPDM

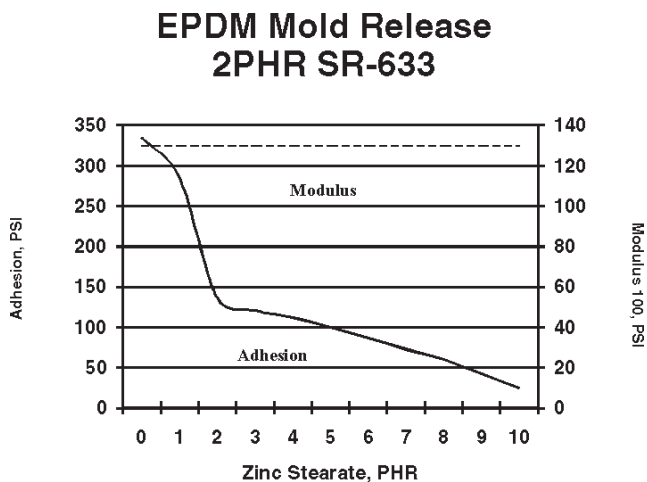
The effect of varying zinc stearate on mold release and properties using SR633, zinc diacrylate coagent, is shown in Table 1.

Table 1: EPDM Mold Release

	1	2	3	4	5	6	7
NORDEL 1040	100	100	100	100	100	100	100
N762 BLACK	100	100	100	100	100	100	100
SUNPAR 2280	50	50	50	50	50	50	50
ZINC OXIDE	5	5	5	5	5	5	5
STEARIC ACID	1	1	1	1	1	1	1
RESIN D	1	1	1	1	1	1	1
DICUP 40KE	7.5	7.5	7.5	7.5	7.5	7.5	7.5
SR633	2	2	2	2	2	2	2
ZINC STEARATE	0	0.5	1	1.5	2	4	10
LAP SHEAR ADHESION, CRS 320°F/20 MIN	310	330	270	170	130	100	15
MOLD RELEASE	Fail	Fail	Fail	Fail/Pass	Fail/Pass	Pass	Pass
HARDNESS	50	50	50	50	50	52	52
TENSILE STRENGTH PEAK, PSI	1000	1030	960	960	1050	1030	1080
ELONGATION, %	980	1000	840	910	920	990	1060
MODULUS ₁₀₀ , PSI	130	130	130	140	140	140	130

Increasing the zinc stearate concentration from 0 to 10 PHR resulted in a progressive improvement in mold release. At the same time, tensile modulus₁₀₀ remained constant as shown in Figure 1. In the range of 5-10 phr zinc stearate, mold release was considered good.

Figure 1



Formulation: EVA

Table 2 shows the effect of zinc stearate on mold release at 2.8 PHR SR633 in ethylene vinyl acetate copolymer Elvax 240. EVA optimum results were achieved at 5 phr zinc stearate. Mold release at this concentration was good and above this zinc stearate level, properties appear to diminish as shown in Figure 2.

Figure 2

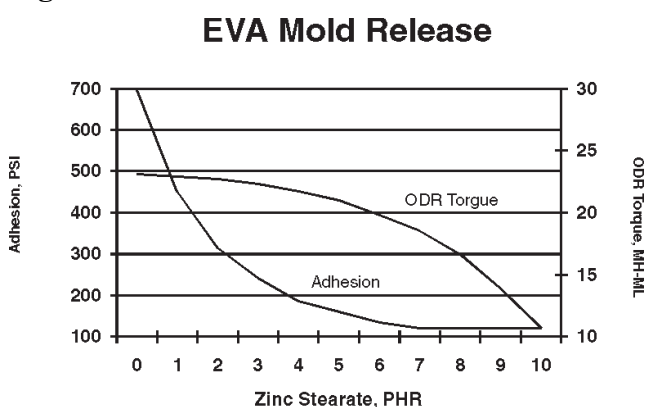


Table 2: EVA Mold Release 2.8 PHR SR633

ELVAX 240	100	100	100	100
HISIL 230	25	25	25	25
ZINC OXIDE	3	3	3	3
STEARIC ACID	3	3	3	3
TOTM	3	3	3	3
PERKADOX 1440	2	2	2	2
SR633	2.8	2.8	2.8	2.8
ZINC STEARATE	0.2	2.2	5.2	10.2
LAP SHEAR ADHESION, CRS 320°F/25 MIN	640A	240A	150A	125A
MOLD RELEASE	Fail	Fail	Fail/Pass	Pass
ODR, 320°F				
ML, IN-LB	3.0	3.1	2.1	1.5
TS, MIN	1.9	1.9	1.2	2.1
TC ₍₉₀₎ MIN	17.7	26.8	20.1	18.2
MH, IN-LB	26.7	26.1	23.1	13.0
MH-ML, IN-LB	23.4	23.0	21.0	11.5

EVA: Alternate Coagents

Similar mold release responses were obtained with zinc dimethacrylate, (SR634) and calcium diacrylate, (SR636). For SR636, the calcium stearate was used to maintain the same metal cation.

The recommended zinc stearate (for SR634) and calcium stearate (for SR636) levels again are 5 phr.

Theory

It is postulated that the zinc stearate competes with the zinc ion in the cured zinc diacrylate network to reduce the number of high energy sites available for bonding at the metal surface. As the metal surface energy is reduced, mold release is obviously improved. The metallic stearates work with any metallic coagent.

Safety Precautions

Materials in this formulation can cause eye and skin irritation and have potential to cause skin sensitization in susceptible individuals. Proper industrial hygiene practices should be utilized. Consult the appropriate MSDSs before using any chemical in this bulletin.