

Reactive Elastomeric Terpolymer (RET) PMA production guide

Equipment and processing suggestions for manufacturing polymer-modified asphalt (PMA)
for paving using ELVALOY™ RET



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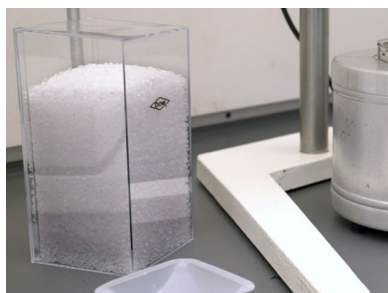
General overview

ELVALOY™ Reactive Elastomeric Terpolymer (RET) is a reactive elastomeric terpolymer that chemically bonds with asphalt (bitumen) and provides elastomeric characteristics to improve the high-temperature performance of the road. The low-temperature properties – below approximately 4°C (40°F) – of terpolymer-modified asphalt are determined mainly by the base asphalt.

Selection of the base asphalt and laboratory evaluations to determine optimum ELVALOY™ RET levels should be completed prior to a production trial. There are two methods for completing the reaction of the ELVALOY™ RET in asphalt:

1. The heat-reacted method to complete the chemical bond with time depending on the asphalt binder.
2. A co-reactant technology method to speed up the reaction time to 1-4 hours.

If you have not completed the laboratory studies, please refer to the Technical Bulletin RET1.1-Laboratory Formulation of ELVALOY™ RET in Asphalt Binder. The ELVALOY™ RET concentration typically ranges from 0.8% to 4.0%, depending on the asphalt stiffness desired and the choice of ELVALOY™ RET Resin. Do not increase terpolymer above laboratory levels without first running a lab test to see if the asphalt will gel at the increased levels of terpolymer. Contract labs can perform initial screenings of this process on your asphalt, and will also provide data according to the applicable standard for the asphalt (AASHTO M320, EN14023, etc.)



ELVALOY™ RET is supplied to asphalt binder producers in the form of free-flowing pellets for measured conveyance and controlled melt-blending into asphalt in a heated mixing tank.

Equipment overview

ELVALOY™ RET is easily mixed into hot asphalt binder, typically using a vertical tank with a top-down rotating mixer assembly that has enough horsepower to create a vortex at the surface in the center of the tank. The system should be able to heat the asphalt to 165-195°C (325-383°F), depending on the reaction method.

Terpolymer pellet addition and co-reactant addition systems are also part of the general equipment layout of a typical ELVALOY™ RET plant operation. For more information and guidelines for setting up a commercial mix tank for processing ELVALOY™ RET, please see Technical Bulletin RET2.2, ELVALOY™ RET Mixing Design Guide.

Blending procedure

ELVALOY™ RET can be reacted with asphalt by one of two methods: heat reacting over a long period of time (up to 24 hours), or by using a co-reactant which usually reduces the total mix time to less than four hours and the terpolymer concentration by approximately 10-20%, depending on the asphalt.

The patented co-reactant technology* uses polyphosphoric acid (PPA), in a concentration ranging from 105-115%. Typically, 0.2% to 0.4% by weight of the asphalt of PPA is used as a co-reactant. The optimum co-reactant level should be determined in laboratory testing prior to commercial production.

Warning: It is critical that polyphosphoric acid is used as the co-reactant instead of standard aqueous phosphoric acid, which is typically less than 85% concentration. Aqueous phosphoric acid can result in serious risks to health and safety, as it may cause any residual water to flash and the hot asphalt to spray out of the tank.

Blend preparation

Blend preparation can be divided into five stages:

- Heating the asphalt
- Adding the ELVALOY™ RET
- Distributing and dispersing the terpolymer (see Mixing Design Guide).
- Adding polyphosphoric acid if using co-reactant technology
- Completing the reaction

The very first PMA production run should be a small-scale trial batch of production (~50 tons). This small run will be used to check the accuracy of the lab scale versus actual production scale.

Heating the asphalt

1. Inspect the mix tank. Flush and empty if necessary before adding the base asphalt. The reaction tank should have less than 5% heel. No residual material other than unmodified asphalt – or leftovers from the previous batch of ELVALOY™ RET modified asphalt – should be present, including co-reactants, acids, caustics, etc., as these materials can have an adverse effect on the reaction between ELVALOY™ RET and the asphalt. The base asphalt must not be pre-acidified.
2. Check that the base asphalt meets the low-temperature specifications. Remember that ELVALOY™ RET modifies the high-temperature properties. The base stock must meet the low-temperature properties.
3. Begin adding the base asphalt to the tank and heat to 185-195°C (365-383°F) for the heat-reacted method, or 165°C (325°F) or higher for the co-reactant technology method.
4. Sample the base asphalt in the blend tank. Measure the rheological properties, such as $G^*/\sin \delta$ at grade temperature. Check other necessary asphalt properties for baseline values.
5. Turn the mixer/agitator and re-circulation pump on. Look through the top of the mix tank to be sure the tank is being vigorously agitated and the mixer is creating a vortex or rough churning to draw the pellets into the asphalt. Do not proceed if the tank is not properly agitating. Adjustments may need to be made to the mixer blade design, motor horsepower, or speed to achieve the desired agitation. Other addition methods should be discussed with your Dow representative.

Adding ELVALOY™ RET

6. For the initial trial, add the ELVALOY™ RET at a rate of 10-15 kg (25-35 lb) per minute. Material should be added as close to the shaft as possible. Avoid pellets touching the shaft, blades, or any other dry hot spot in the tank to prevent pellets from sticking. Look through the top of the tank periodically to ensure that there is not terpolymer buildup or clumped pellets floating on the asphalt – these are signs of poor agitation.

If build-up is observed, halt the addition of terpolymer and allow clumps or buildup to mix completely before resuming at 2 kg/min (5 lb/min) less than the previous rate. Repeat this step until no terpolymer buildup is observed after one hour of continuous addition. After the terpolymer is mixed in, restart the terpolymer addition at a rate of 2 kg/min (5 lb/min) less than the previous rate. Repeat this step as needed until no terpolymer buildup is detected after one hour of continuous terpolymer addition.

7. If no terpolymer build-up is observed at 15 kg/min (30 lb/min) for 15 minutes, increase terpolymer addition rate by 10 lb/min. Wait 15 minutes. If there is no terpolymer build-up, increase the rate by another 10 lbs. per minute. Repeat this step as needed until either terpolymer build-up occurs or maximum terpolymer feeder rates are achieved. If terpolymer buildup is detected, reduce the feed rate to the previous setting that did not lead to buildup. If terpolymer accumulation continues, stop adding new material until the buildup is eliminated.
8. Continue adding ELVALOY™ RET until the desired amount has been added.

Note: After the optimum terpolymer addition rate is determined, continue to check this rate over the next few production runs to ensure no build-up forms on the surface of the asphalt blend.

Distributing and dispersing the terpolymer

9. Once all the ELVALOY™ RET has been added, look through the top of the tank to ensure that all the terpolymer has been dissolved (no floating pellets). Continue to agitate, heat, and circulate the contents of the tank for the remainder of the reaction time.
10. Sample the tank and run the rheological properties at grade temperature. The viscosity measurement should be used to monitor the rate of reaction. Continue with the specific procedures below to complete the ELVALOY™ RET reaction process.

Section A: Heat reacted method (steps 11-14)

Note: If using the co-reactant method, skip to Section B (next page) to steps 16-25.

Completing the reaction

11. Continue monitoring the rheological properties every four to six hours.
12. Once the monitored property reaches equilibrium, the reaction is complete. This usually will take 12 to 24 hours depending on the asphalt, but possibly as soon as four hours. The terpolymer modified asphalt should be tested to ensure that it meets all desired specifications.
13. The PMA can now be pumped into a finished product storage tank. The storage tank should have a gentle mixer to maintain even tank temperatures. The PMA will not separate or settle out of the asphalt since the ELVALOY™ RET has been chemically reacted with the asphalt. If long-term storage of the PMA is needed, the asphalt can be cooled and re-heated.
14. Before starting another batch of ELVALOY™ RET modified asphalt, the reaction tank should have less than 5% heel in the tank to prevent gels during ELVALOY™ RET addition. Residue of co-reactant, acid, caustics, etc. can have an adverse effect on the reaction between ELVALOY™ RET and the asphalt.

Section B: Co-reactant technology method

Note: When using polyphosphoric acid as a co-reactant, follow recommended safety/handling practices as specified by the polyphosphoric acid suppliers.

Complete steps 1-10 (above) in the common procedure.

- Continue mixing and maintaining tank temperature at 165°C (325°F) or higher.
- Once all the ELVALOY™ RET has been added, look through top of the tank to ensure that all of the terpolymer has been dissolved.

Note: Do not proceed with adding the co-reactant until all of the terpolymer has been dispersed. Dispersion usually takes approximately one to two hours after the addition of the terpolymer pellets.

- Sample the asphalt and take to the lab. Test the sample by adding polyphosphoric acid. Testing should never be done outside of a lab setting. Look for gel formation and compare rheological properties to previous lab formulation results to verify the material is within specification. If no gel formation is observed, proceed with adding polyphosphoric acid as outlined in step 19.

Note: It is extremely difficult to disperse ELVALOY™ RET in asphalt after acid has been added due to the reaction between ELVALOY™ RET and polyphosphoric acid.

Adding polyphosphoric acid

- Keep the recirculation flowing, the heat on and mixer running for at least one hour after completing ELVALOY™ RET addition.
- With the mixer running, begin injecting the polyphosphoric acid (PPA) through the top of the tank or into the recirculation line of the tank at the discharge of the recirculation pump. If 0.2% acid (by weight) is desired in the asphalt, inject PPA at a rate near the addition level into the recirculation line, e.g., if recirculation flow of 45 MT/h (100,000 pph) and 0.2% acid is desired, inject acid at 0.1 MT/h (200 pph).

Warning: Should recirculation flow be lost at any point during the co-reactant injection, shut down the acid injection flow immediately. Injecting acid into a no-flow asphalt line could cause the asphalt to gel, plugging the line. It is strongly recommended that the acid pump be interlocked down on the loss of the recirculation pump.

- Continue injecting the acid until the desired amount has been added. During the acid addition and until the reaction is complete, keep the agitator and recirculation pump running and maintain the temperature at 185°C (365°F).

Completing the co-reactant reaction

- Check the asphalt rheological properties every hour.
Do not add more ELVALOY™ RET to the tank after PPA is added.
- Once the rheological properties reach equilibrium, the reaction is complete – usually 30 to 60 minutes after all acid has been injected. The PMA should be tested to ensure that it meets all end-use specifications.
- The PMA can now be pumped into a finished product storage tank. The storage tank should have a gentle mixer to maintain even tank temperatures. The PMA will not separate or settle out of the asphalt, as the ELVALOY™ RET has been chemically reacted with the asphalt. If long-term storage of the PMA is needed, the asphalt can be cooled, and reheated.
- Before starting another batch of ELVALOY™ RET-modified asphalt, the reaction tank should have less than 5% heel in the tank to prevent gels during ELVALOY™ RET addition. Residue of co-reactant, acid, caustics, etc., can have an adverse effect on the reaction between ELVALOY™ RET and asphalt.

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