Technical Bulletin RET2.2

Equipment design considerations for the mixing of DuPont™ Elvaloy® RET in polymer-modified asphalt (PMA) binder for paving.
Overview

DuPont™ Elvaloy® RET asphalt modifier effectiveness and maximum performance requires adequate mixing. Because only a small amount of Elvaloy® RET is added to the asphalt; and because the terpolymer is reactive, proper mixing helps assure that the RET pellets are well distributed and that the RET molecules are stretched out and dispersed quickly, to react with the available asphaltenes.

Distributive and Dispersive Mixing \(^{(1)}\)

Distributive mixing is defined as providing spatial uniformity of all the components.

Dispersive mixing is defined as the breakup of agglomerates or lumps to the desired ultimate grain size of the solid particulates, or the domain size (drops) of other immiscible fluids.


Mixing Parameters

There are three keys to ensuring both distribution and dispersion are completed:

1. Elvaloy® pellets must be submerged as soon as they come into contact with the asphalt.
2. Mixing should be sufficiently turbulent to distribute the pellets around the tank.
3. Mixing energy must be adequate to break up and diffuse the viscous melted terpolymer into the asphalt (not the same as shear milling).

Consult with your tank and agitator supplier for specifics.

Key 1: Elvaloy® pellets must be submerged as soon as they come into contact with the asphalt.

Elvaloy® RET is reactive and has lower density than asphalt. If pellets are left floating on top of the asphalt, they can melt together and eventually react, forming a skin or layer.

Successful Elvaloy® mixing starts with top-down mixer using pitched-blade impellers turning fast enough to create a vortex and turbulence to distribute the pellets as they melt. Tank baffles and mixer impellers should be designed to provide a vortex to draw the RET pellets into the hot asphalt. Other addition methods should be discussed with DuPont technical representative.

Key 2: Mixing should be sufficiently turbulent to distribute the pellets around the tank.

Turbulence is estimated by calculating an impeller Reynolds Number \(N_{RE}\) which is based on the impeller speed and size and the particular fluid viscosity. For mixing Elvaloy® RET pellets the Reynolds Number should be higher than 20,000 for the unmodified asphalt.

\[
N_{RE} = \frac{\rho \ d^2 \ h}{\mu}
\]

\(\rho\) is density of the asphalt liquid, \(g/cm^3\); \((lb/ft^3)\)
\(d\) is impeller diameter, cm; (ft)
\(h\) is impeller speed, revolutions per second; (RPM/60 seconds per minute)
\(\mu\) is viscosity, Poise; (lb/ft second)

Turbulence can be increased by increasing the impeller diameter or speed (rpm) or reducing the viscosity of the asphalt (higher temperature).
**Key 3: Energy must be adequate to break up and diffuse the viscous melted terpolymer into the asphalt.**

Mixing by the impeller as it shears the terpolymer and asphalt, will reduce the pellet size and allow the Elvaloy® RET molecules to stretch out and disperse with the asphaltenes. To ensure adequate dispersion of higher viscosity melted terpolymer into lower viscosity asphalt, the mixer should be designed to draw at least 0.2 hp/ton asphalt. The mixer designer should provide this information, but it can be estimated by calculating about 75% of the total impeller power draw:

\[
\text{Power Draw} = n P_o \rho h^3 d^5 / C
\]

- \(n\) is number of impeller sets (not blades)
- \(P_o\) is the power number of the impeller set (from supplier)
- \(\rho\) is density of the asphalt liquid, g/cm\(^3\) (lb/ft\(^3\))
- \(h\) is impeller speed, revolutions per second; (RPM/60 seconds per minute)
- \(d\) is diameter of the impeller, cm; (ft)

\[
C = 7.457 \times 10^9 \left( \frac{\text{g cm/sec}^2 \times \text{cm/sec}}{\text{hp}} \right)
\]

**Mixer Examples**

**Vertical Mix Tank – 200 tons**

- Tank diameter: 270 inches
- Liquid level: 270 inches
- Mixer: 75 hp turning impellers @ 60 rpm
- Impellers: 3 sets pitch blade, 4 blades/set, 66 inches diameter.

**Horizontal Mix Tank**

- Tank Volume: 25-30 cubic meters
- Tank Diameter: 250 cm
- Mixer: 2 mixers spaced 1/3 of the distance to the end of the tank. 15 hp each turning impellers @ 100-120 rpm
- Impellers: 2 sets pitch blade, 3 blades/set, each blade 50 cm long.

**Additional Information**

The mixing should continue long enough to allow the Elvaloy® to uniformly spread and disperse, typically 2-3 hours after all terpolymer has been added. (See DuPont Technical Bulletin RET2.1 for further PMA production information.) The reaction can continue aided by heat or catalyst. See also DuPont Technical Bulletin RET1.1, “Suggested Guidelines for Initial Screening of Elvaloy® RET in Asphalt for Paving Applications.”
Disclaimer

This information corresponds to our current knowledge on the subject. It is offered solely to provide possible suggestions for your own determinations. It is not intended, however, to substitute for any testing you may need to conduct to determine for yourself the suitability of our products for your particular purposes. It is the user’s responsibility to determine the level of risk and the proper protective equipment needed for the user’s particular purposes. This information may be subject to revision as new knowledge and experience becomes available. Since we cannot anticipate all variations in actual end-use conditions, DUPONT MAKES NO WARRANTIES AND ASSUMES NO LIABILITY IN CONNECTION WITH ANY USE OF THIS INFORMATION. Nothing in this publication is to be considered as a license to operate under or a recommendation to infringe any trademark or patent right.

For additional information on safety and handling of DuPont™ Elvaloy® RET asphalt modifiers, please read the Material Safety Data Sheet. If further assistance is needed, contact DuPont Packaging and Industrial Polymers at a regional office near you.