Redicote AP Asphalt Additive

What is Asphalt?

Asphalt is a complex mixture of hydrocarbons derived from crude oils and is defined by its rheological (viscosity) properties. Asphalt has a colloidal structure: high molecular weight hydrocarbon solids (asphaltenes) are dispersed in lower molecular weight resins and oils. The colloidal stability of the asphalt affects not only its desirable rheological properties but also its ease of emulsification and the curing and cohesion in emulsion systems. Low colloid stability results in poor resistance to age hardening, poor compatibility with polymeric additives, difficult to emulsify asphalt and poor emulsion properties.

The primary effect of Redicote AP asphalt additive is to stabilize the asphalt colloidal system; a secondary effect is to improve the adhesivity of the asphalt towards aggregate.

Effect of Redicote AP on the Colloidal Stability of Asphalt

The colloidal stability of asphalt is determined by the so-called 'flocculation ratio' tests. Asphalt is diluted in mixtures of heptane and xylene. Heptane tends to destabilize the asphalt causing flocculation of the asphaltenes. Asphalts with high colloidal stability can tolerate a higher proportion of heptane in the mixed solvent without flocculation occurring.

	Flocculation Ratio*	
	Untreated	Treated With 0.5% Redicote AP
30 pen asphalt	42.5	37.5
SBS modified asphalt	27.5	22.5

*****% xylene in xylene-heptane mixture at which flocculation first occurs

Redicote AP treated asphalt has a significantly lower flocculation ratio than untreated asphalt.

Age-Hardening of Asphalt

Asphalt ages during the manufacture and handling of bituminous materials and then more slowly during the lifetime of the road itself. The changes involve the evaporation of low molecular weight components and oxidation, resulting in an increase in viscosity and a decrease in the colloidal stability of the asphalt. Hardening of the asphalt can lead to cracking of the roadway. The lower colloidal stability can lead to partial separation of polymer modifiers and the consequent loss of elastic properties. The age hardening of asphalt can be simulated by an accelerated laboratory test called "The Rolling Thin Film Oven Test" (RTFOT) in which a film of asphalt is heated in a stream of air. After this treatment the asphalt is recovered and its viscosity is compared with that of untreated asphalt. The ratio of the viscosities of untreated and treated asphalt is known as the aging index.

Level of Redicote AP	*Aging Index*
None	2.32
0.5%	1.90
1.0%	1.78

The above table shows the results for a particular 40 pen asphalt. An aging index of 1.0 (i.e. no change) is not achievable because some volatiles are inevitably lost, but treatment with Redicote AP reduces the aging index significantly.

The aggregate itself can influence the age-hardening process. The RFTOT is performed in glassware. A more realistic test has been developed by the testing institute IFTA (Ingenieurgesellschaft für Technische Analytik GmbH). In this test hot air (140°C) is passed through an open-graded bituminous mixture followed by extraction of the asphalt. The softening point of the extracted asphalt is compared with untreated asphalt. The table below shows results for a B60/70 pen asphalt and basalt aggregate.

Level of Redicote AP %	Softening point °C		
	Before Test	After Mixing	After Aging
0	51	56	58
1	51	55	55

Treatment with Redicote AP leads to a significantly smaller increase in softening point during mixing and aging.

Adhesion of Asphalt in Hot-Mix

In addition to its anti-hardening effect, Redicote AP also acts as an effective heat-stable antistripping agent in hot-mixed materials.

Coverage After 48 Hours Immersion at 60°C

Untreated	40%
0.3% Redicote AP	90%
0.4% Redicote AP	95%

asphalt: 180/200 pen Venezuelan *aggregate: diorite*

Emulsion Properties

Redicote AP addition to the asphalt results in a smaller particle size of the emulsion droplets, which gives improved storage stability (lower settlement) and higher viscosity. Setting rate is not significantly affected. See Figure 1.

The adhesion onto the aggregate of the cured film resulting from setting of emulsion ensures the durability of the surfacing. In a typical accelerated laboratory test, aggregate chippings are coated with emulsion, allowed to cure and then immersed in hot water. The coverage of the aggregate after immersion is estimated visually. See Figure 2.

Figure 1. Effect of Redicote AP on the Properties of a CRS-1 Emulsion

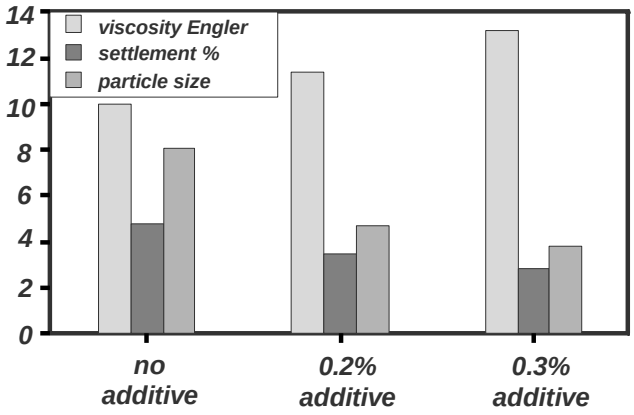
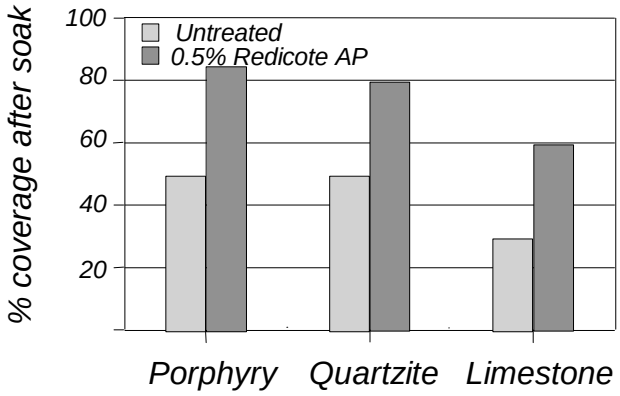


Figure 2. Effect of Redicote AP on the Adhesion of Cured Emulsified Asphalt Films



Penetrating Power of Tack Coat and Prime Coat Emulsions

Tack coat emulsions should penetrate dust on the road surface to ensure a good bond. The time taken for a tack coat emulsion to soak into a quartz powder is used in a German standard test as a measure of the penetrating power of tack coats. Redicote AP clearly improves the wetting, enabling a substantial reduction in emulsifier usage.

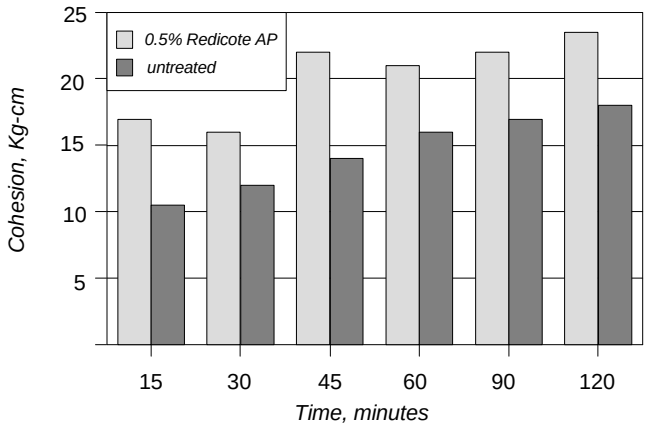
Effect of Redicote AP on the Penetrating Power of Tack and Prime Coat Emulsions

Emulsifier level %	Redicote AP %		Time taken to soak into quartz sand (minutes)
	On asphalt	On emulsion	
0.8	0	0	>20
0.9	0	0	>20
1.2	0	0	8
0.8	0.1	0.04	6
0.8	0.3	0.12	5
0.8	0.5	0.20	3
0.9	0.3	0.12	4

Slurry Seal Emulsions

Cohesion development in slurry systems can be measured in the laboratory. Slurries prepared from asphalt containing Redicote AP develop cohesion faster. See Figure 3.

Figure 3. Cohesion Development in Slurry Based on Redicote E-11 Emulsifier



Summary

Property	*Effect of Redicote AP*
adhesion in hot mixes	Improved
age-hardening of asphalts	Slowed down
emulsion particle size	Reduced
emulsion viscosity	Increased
emulsion settlement	Reduced
Setting rate of rapid-set emulsions	Unaffected
curing behavior of slurries	Improved
Penetrating power of tack coats and primes	Improved
adhesion in emulsion systems	Improved