

'Rijkswaterstaat' (Roads, Waterways and Dykes Authority)

1. Introduction

Unfortunately, accidents happen regularly on the Dutch motorways. Often damage is limited to some dents in the bodywork, but sometimes there is more damage and a.o. oil flows out of the wreckage. As both traffic and road surface in particular may suffer damage from the presence of oil, it is the responsibility of the road maintenance authorities to remove this pollution. The local services of 'Rijkswaterstaat' (Roads, Waterways and Dykes Authority) therefore have cleaning agents at their disposal in order to remove this oil. This cleaning process is particularly a problem in relation to 'Zeer Open Asfalt Beton (ZOAB)' [very open bitumen/concrete mixture], where oil gets into the pores and can have intensive contact with the bitumen. The usual absorption agents for closed surfaces, cannot be used with ZOAB, so that often liquid cleaning agents are applied. In this test these agents have been investigated.

Objectives

At this moment the various local regions of 'Rijkswaterstaat' use a large range of liquid cleaning agents for ZOAB. This note gives an assessment of the agents currently in use by Rijkswaterstaat. In total, twenty cleaning agents (attachment 1) have been tested, of which the large majority is already used by Rijkswaterstaat.

Using the dilution as advised by the distributor, the cleaning agents have been tested for:-

- ◆ Cleaning effectiveness
- ◆ Damage to the bituminous road surface
- ◆ Environmental aspects of the soil and groundwater

In addition to these three aspects, the cost of the cleaning agents has also been taken into account in this evaluation. In addition, test criteria for the three aspects mentioned above, that will have to be met by current and future cleaning agents used by Rijkswaterstaat, have been developed in

this investigation. Based on this, a test standard for Rijkswaterstaat has been formulated for these agents (attachment 3), which eventually will need to be adopted as a national standard. In addition, attachment 4 gives general cleaning guidelines.

The investigation was carried out during the period January 1998 to July 1999 by a Rijkswaterstaat project team of the Division Roads and Waterways at Delft, supervised by project leader F.Sanches. The Rijkswaterstaat East Netherlands Directorate has sponsored this investigation.

Cleaning Action

Cleaning action is the effectiveness with which agents remove the oil from a ZOAB road surface. This has been tested using the modified Baumgartner test, in which the percentage of oil is determined, that can be removed from a glass surface by a cleaning agent (at the concentration as advised by the distributor). Furthermore, tests have been carried out to determine how much the agents can be diluted, while still meeting the requirement of 50% cleaning action.

In addition to the cleaning action, the emulsion stability has been determined. Emulsion stability is the condition where oil is dispersed or dissolved in the cleaning agent. Cleaning agents need to have a certain emulsion stability, as it takes some time to remove the oil from the road surface. The test on emulsion stability determines the amount of emulsion after 6 hours of intensive contact between oil and cleaning agent.

In addition, it is determined whether oil comes out of the emulsion. The cleaning test has been conducted by the 'TNO-Delft Institute voor Reinigingstechnieken' (Institute for Cleaning Technology). The cleaning action in the first column is weighted with a factor 3, as this property is as important as the other three properties together.

Table 1 - Assessment Cleaning Effectiveness Road Cleaning Agents

	Cleaning Score	Factor x 3	Max. dilution 50% clean	Factor x 1	6 hour emulsion %	Factor x 1	Oil in emulsion	Factor x1	Conclusion
Bio Nonex	80	+++	>500	+++	100	+++		+++	+++
Oil Control	74	+++	140	+	100	+++		+++	+++
Chrisal	71	+++	150	+	100	+++		+++	+++
Eco-press	64	++	>500	+++	55	++	Oil	+	++
TriStar	63	++	120	+	39	++		+++	++
WAF	63	++	>500	+++	49	++		+++	++
Lavor	62	++	200	++	44	++	Oil	+	++
Vetrij	62	++	300	++	98	+++	Oil	+	++
Corvet	62	++	270	++	55	++		+++	++
Aqua-sol	61	++	120	+	97	+++	Oil	+	++
Indufoam	60	++	140	+	100	+++		+++	++
Slikoff	58	++	100	+	100	+++		+++	++
Turco Plaudit	57	++	220	++	98	+++		+++	++
Oil X	55	++	>500	+++	51	++		+++	++
Super Tec Clean	55	++	>500	+++	45	++		+++	++
Soix 25	55	++	30	+	100	+++		+++	++
Elynol Bl	54	++	150	+	51	++	Oil	+	++
Aquaquick	54	++	300	++	50	++		+++	++
Road Bio	53	++	>500	+++	45	++	Oil	+	++
Q-4D	50	++	50	+	20	+		+++	++

+++ = Good
 ++ = Satisfactory
 + = Poor

From the investigation it is apparent that, in accordance with the requirements as determined by Rijkswaterstaat, all agents are satisfactory with respect to their cleaning effectiveness. The requirements are based on the fact that all agents are operationally acceptable. The agents Bio Nonex, Oil Control and Chrisal are good.

The emulsion stability after 6 hours is satisfactory for all agents except one. With a number of products the emulsion after 6 hours is still 100%. In a small number of cases oil sometimes comes out of solution. There is, by the way, no direct relationship between cleaning action and emulsion stability.

A large number of agents can be diluted further than officially indicated while still maintaining about 50% cleaning effectiveness. This extra dilution can be advantageous with respect to possible environmental effects.

Erosive Properties

By erosive properties we mean the tendency of the cleaning agent to remove or change the binder material of the bitumen. It is certainly possible for the bitumen to weaken under the influence of cleaning agents. This has been investigated by visually judging the erosion after ZOAB core material had been exposed to diluted cleaning agent for 6 days and by determining the properties of the recovered binder material. By modification of the properties we mean the change in penetration of the bitumen.

Table 2 - Assessment Of Erosion Of The Road Surface By Cleaning Agents

	Visial Erosion	Assessment	Surface Penetration Change (6 hours)	Assessment	Conclusion
Bio Nonex	Strong Stripping	+	460	+	+
Oil Control	Light Stripping	++	75	+	+
Chrisal	Discoloration	++	95	+	+
Eco-press	Light Stripping	++	54	+++	++
TriStar	None	+++	53	+++	+++
WAF	None	+++	48	+++	+++
Lavor	None	+++	80	+	++
Vetrij	Strong Stripping	+	74	+	+
Corvet	None	+++	52	+++	+++
Aqua-sol	None	+++	50	+++	+++
Indufoam	None	+++	55	+++	+++
Slikoff	None	+++	55	+++	+++
Turco Plaudit	None	+++	92	+	++
Oil X	Discoloration	++	55	+++	++
Super Tec Clean	None	+++	50	+++	+++
Soix 25	None	+++	55	+++	+++
Elynol Bl	Light Stripping	++	58	+++	++
Aquaquick	None	+++	57	+++	+++
Road Bio	None	+++	50	+++	+++
Q-4D	Light Stripping	++	70	++	++
Blanco	None	+++	50	+++	+++

- +++ = no erosion and no change in road surface (binder material)
- ++ = erosion or change in road surface (binder material)
- + = erosion and change in road surface (binder material)

The investigation of the erosion properties was performed by the IL Laboratory of the Division Roads and Waterways at Delft.

From the investigation it is apparent that the agents Bio Nonex and, to a slightly lesser degree, Vervrij cause erosion of the binder material and weaken it. To a lesser extent this also holds for Oil Control and Chrisal. From research it appears that this modification of the properties of the binder material does not directly cause changes in the mechanical properties of the ZOAB, however.

The agents TriStar, WAF, Corvet, Aqua-sol, Indufoam, Slikoff, Super Tec Cleaner, Siox 25, Aquaquick and ROAD BIO do not show any erosion. The remainder show either minor erosion or change in the binder material. It is expected that erosion will only occur after the bitumen has been in contact with the cleaning agent for days on end. With liberal rinsing of the agents it is anticipated that erosion will hardly occur in practice.

Environmental Aspects

When using cleaning agents on the road, by far the most disappears onto the verge, it is therefore necessary to test the environmental impact of the agents on the soil.

Cleaning agents contain surface reactive agents ('tensides'), complexforming agents, alkalides, solvents, antifoaming agents, fragrance and dyes. A number of these substances are damaging to the environment.

Based on information provided by the distributors, the Chemiewinkel ('Chemistry Shop') of Amsterdam University has performed an environmental scan. This scan takes into consideration the disintegration, the mobilisation (complexforming agents), the pH, the presence of organic solvents, the harmfulness to man and the toxicity in the soil.

By harmfulness to man we mean that no irreparable damage, hypersensitivity and carcinogenic/mutagenic damage may be caused. Despite the absence of any such effects, one has to realise that, in high concentrations, cleaning agents, are usually harmful to man.

Table 3 - Assessment Of The Environmental Aspects Of Road Surface Cleaning Agents

	Disintegration	Mobilisation	Ph	Solvent	HSE & Conditions of Employment	Ecotoxicity	Final Result
Bio Nonex	+	+	+	+	+	-	++
Oil Control	+	-	+	+	+	-	+
Chrisal	-	+	+	+	+	+	+
Eco-press	-	+	+	+	+	-	+
TriStar	-						+
WAF	+	-	+	+	+	+	+
Lavor	+	+	+	+	+	+	+++
Vetrij	+	+	+	+	+	+	+++
Corvet	+	-	+	+	+	+	+
Aqua-sol	+	+	+	+	+	+	+++
Indufoam	+	+	+	+	+	+	+++
Slikoff	-	+	+	+	+	-	+
Turco Plaudit	+	+	+	+	+	-	++
Oil X	+	+	+	+	+	-	++
Super Tec Clean	-	+	+	+	+	+	+
Soix 25	-	+	+	+	+	+	+
Elynol B1	+	+	+	+	+	-	++
Aquaquick	+	+	-	+	+	-	+
Road Bio	+	+	+	+	+	+	+++
Q-4D	-	+	-	+	+	+	+

Individual Property = + = Satisfactory
 - = Inadequate

Final Result = +++ = Satisfies All Criteria
 ++ = Satisfies first 5 Criteria
 + = Does not Satisfy the first 5 Criteria

Requirements have been formulated with respect to the first five parameters. Cleaning agents should satisfy these requirements. The final column gives an assessment of this aspect; an indication of ecotoxicity is taken into consideration as well.

The agents Oil Control, Chrisal, Eco-press, TriStar, WAF, Corvet, Slikoff, Super-Tec Cleaner, Siox 25, Aquaquick and IQ-4D do not meet all five above mentioned criteria. That does not mean that these agents should not be used for cleaning activities on the road. When these agents are used, a lot of attention should be paid to cleaning up the road afterwards. These agents should not be allowed to run into the verge.

The other agents satisfy the five criteria. This does not mean that these can be hosed down into the side of the road. On the contrary, cleaning agents are not meant to be disposed of in the environment. As a consequence the law, e.g. the Law on Environmental Protection, does not allow these kinds of agents to enter into the environment. In special circumstances one can obtain an exemption from the relevant authorities. The best approach is to collect these agents after use and deliver them to a suitably licenced waste disposal company.

Price

Obviously, the price of road cleaning agents is important for cost limitation purposes. A review from 1993 showed that Rijkswaterstaat used approximately 2000-3000 kg of undiluted liquid cleaning agent at the time. In view of the extended use of ZOAB in the road system, it is to be expected that the use will only increase.

Table 4 - Price Of Road Cleaning Agents

	Price (NLG/L)	Price / Dilution	Final Assessment
Bio Nonex	70	$70/50 = 1,4$	+
Oil Control	6,9	$6,9/5 = 1,38$	+
Chrisal	7	$7/10 = 0,7$	++
Eco-press	30	$30/25 = 1,2$	+
TriStar	4	$4/10 = 0,4$	++
WAF	5	$5/15 = 0,33$	+++
Lavor	3	$3/15 = 0,2$	+++
Vetrij	7	$7/25 = 0,28$	+++
Corvet	5	$5/20 = 0,25$	+++
Aqua-sol	22	$22/10 = 2,2$	+
Indufoam	12	$12/15 = 0,8$	++
Slikoff	10	$10/15 = 0,66$	++
Turco Plaudit	5,5	$5,5/15 = 0,36$	+++
Oil X	16	$16/10 = 1,6$	+
Super Tec Clean	11	$11/10 = 1,1$	+
Soix 25	28	$28/10 = 2,8$	+
Elynol Bl	5	$5/10 = 0,5$	++
Aquaquick	30	$30/50 = 0,6$	++
Road Bio	5	$5/15 = 0,33$	+++
Q-4D	30	$30/50 = 0,6$	++

+++ = Cheap
 ++ = Average
 + = Expensive

From the above table (table 4) it is clear that there is a big price difference between the various cleaning agents (prices of May 1999). In the assessment of price the dilution recommended by the distributor has been taken into account. A price of less than NLG 1 - per litre undiluted agent seems reasonable.

Final Assessment

In the table below all test aspects have been combined. Weighting factors have been assigned to the various properties. Rijkswaterstaat considers the environmental aspects to be the most important, therefore, we have assigned this a large weighting factor (*6). In so doing, we considered that the environmental aspects were of equal importance to the cleaning and erosion properties combined. The project group is of

Table 5 - Final Assessment Of Road Surface Cleaning Agents**Appendix One**

	Cleaning Effectiveness * 3	Erosion (None) * 3	Environmental Aspects * 6	Price * 2	Final Assessment
Bio Nonex	A	C	B	C	B
Oil Control	A	C	C	C	C
Chrisal	A	C	C	B	C
Eco-press	B	B	C	C	C
TriStar	B	A	C	B	C
WAF	B	A	C	A	C
Lavor	B	B	A	A	A
Vetrij	B	C	A	A	A
Corvet	B	A	C	A	C
Aqua-sol	B	A	A	C	A
Indufoam	B	A	A	B	A
Slikoff	B	A	C	B	C
Turco Plaudit	B	B	B	A	B
Oil X	B	B	B	C	B
Super Tec Clean	B	A	C	C	C
Soix 25	B	A	C	C	C
Elynol Bl	B	B	B	B	B
Aquaquick	B	A	C	B	C
Road Bio	B	A	A	A	A
Q-4D	B	C	C	B	C

A = Excellent
 B = Good
 C = Not acceptable