

## STUDIES CONCERNING HEAT-RESISTING ADDITIVES FOR BITUMENS – ADETEN TYPE

BY

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**Abstract.** The improvement of causeway's bitumen adhesiveness is becoming a current practice in our country, especially when is used acid (siliceous) aggregate. One of the most important properties of bitumen is its adhesiveness to aggregate, and this property determine the using of bitumen in causeways area. Usually the adhesiveness is defined as the capacity of a binder to cover an aggregate without dispersing itself when touching the water or the traffic aggressions. Therefore, the adhesiveness additives are products that improve the adhesiveness of the bitumen to a certain aggregate. The used additives – ADETEN type (A01 and A03) – have a high stocking stability, a low toxicity degree toward the amine, diamine, polyamine-based additives and are liquid products perfectly compatible with all bitumens and easy to use, in comparison to the paste or solid additives, which must be made liquid to be used. But a very important condition, which must be fulfilled by these promoters is the heat-resisting condition.

**Key Words:** Bitumen; Adhesiveness; Heat-Resisting Additives.

### 1. Introduction

In last years, there is a strength tendency to use surface-active products like additives, which considerable ameliorate the adhesiveness of bitumen. In fact, this is a result of composition and specific molecular structure (polar - non-polar) of additive. The additive has a lyophilic group that fixes into the bitumen and a hydrophilic group that fixes at the natural aggregate surface.

The bitumen is a natural or an artificial product, its consistency is fluid or semi-solid, dark coloured (from brown to black) and is constituted by complex organic compound with colloidal structure [1].

### 2. About the Used A01 and A03 Adhesiveness Additives [2]

The adhesiveness is defined by means of several complex phenomena that occur when the bitumen - aggregates takes place, some of them being physical or physical - chemical phenomena (such as the texture of the aggregate surface and the porosity and viscosity of the bitumen, interfacial tension). The adhesiveness agents are surface agents capable of modifying the aggregate - bitumen interfacial tension and of allowing the aggregate to be wetted by the bitumen. The

adhesiveness agents improve as well the resistance of the binder so that it should not be moved by water after it is fixed on the aggregate surface.

The aggregates that are always in contact with water have an electric charge on their surface due to the ionization of their molecules. The sign of this charge allows their classification in acid aggregates and basic aggregates.

*Acid aggregates* (quartz, granite, porphyry) are especially silicates, which forms  $\text{SiO}_3^{2-}$  – negatively charged ions, on their surfaces (in the presence of water). The *basic aggregates* (calcite) are especially carbonates that form  $\text{Ca}^{2+}$  – positively charged ions, in the presence of water.

The bitumen contains polar compounds, such as asphalts or resins. In these complex molecules, the presence of acid groups generate a negative behaviour when water makes contact with the bitumen surface. These acid molecules position themselves from the bitumen to the sole possible direction, towards the surface, due to the acid group that is hydrophilic, covering the bitumen particles with a negative charge.

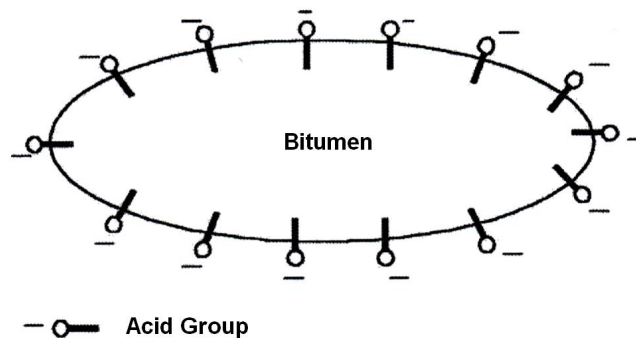


Fig. 1. – Bitumen surface with negative charge.

With this simple concept, it will be easier to understand that when the bitumen makes contact with a calcareous aggregate ( $\text{Ca}^{2+}$ ), an electrostatic attraction force appears between the ions with different electrical charges on both surfaces, thus certain degree of adhesiveness is created.

On the other hand, when the bitumen makes contact with a siliceous aggregate, the negative ions on both surfaces generate repulsion that stops adhesiveness.

The adhesiveness agents provide a positive charge on the bitumen surface, allowing an electrostatic connection with the negative siliceous aggregates and improving the adhesiveness.

The bitumen/aggregates adhesiveness can be improved by using the A01 and A03 adhesiveness additives, which

a) can modify the interfacial conditions between the aggregate and bitumen so that the bitumen may adhere even to difficult-to-cover aggregate.

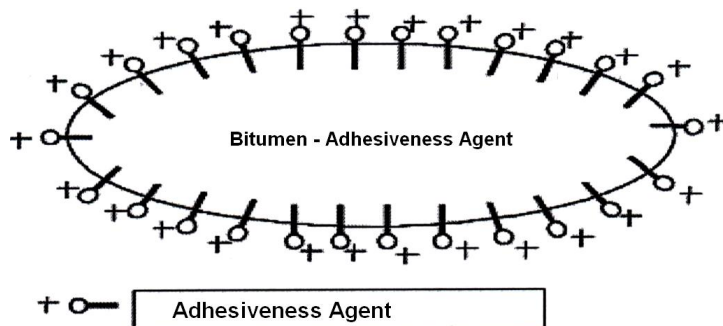


Fig. 2. – Bitumen surface positive charged by adhesiveness agents.

b) can improve the adhesive connection between the aggregates and the bitumen, thus increasing the long term resistance to the de-wetting of aggregates because of the water.

The A01 and A03 additives are surface-active products, with a specifically polar composition and structure, being made of

- a) Lyophilic group that fixes into the bitumen.
- b) Hydrophilic group that fixes at the natural aggregate surface.

From the point of view of the chemical character, the A01 and A03 additives are amidoamines, imidazoline ethyleneamines, imidazoline ethanolamines.

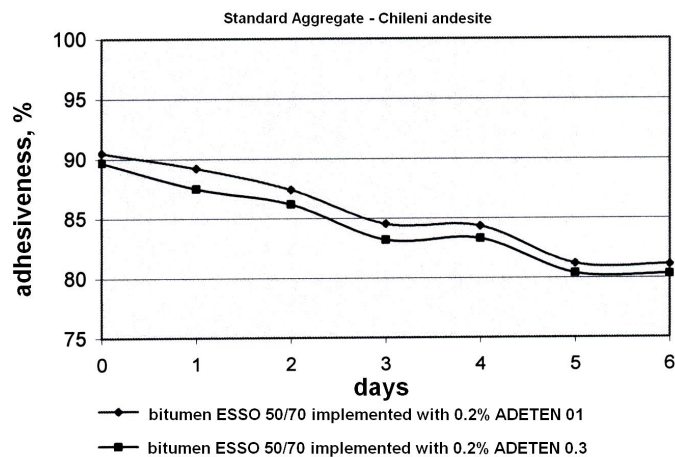
### 3. Heat-Resisting of A01 and A03 Additives Compound with a Causeway Bitumen ESSO 50/70

Heat-resisting of additives in bitumen depends on chemical composition of used bitumen and on storage temperature of bitumen.

Heat-resisting of A01 and A03 additives compound with a causeway bitumen ESSO 50/70 was determined measuring the adhesiveness of bitumen (doped with 0.2% A01 and 0.2% A03). Like aggregate has been used etalon-aggregate (by Chileni). The adhesiveness has been measured every 24 h, all this time the bitumen has been kept on 155°C.

The adhesiveness of ESSO 50/70 bitumen doped with 0.2% A01 is decreasing every day (in first five days of storage, on 155°C) with 1.5...3.2%. After that, the adhesiveness decreases (on the same temperature) and becomes negligible (s. Table 1).

The adhesiveness of ESSO 50/70 bitumen doped with 0.2% A03 is decreasing every day (in first five days of storage, on 155°C) with 1.3...2.9%. After that, the adhesiveness decreases (on the same temperature) and becomes negligible (s. Table 2).



**Fig. 3.** – Variation of bitumen adhesiveness in time.

**Table 1**

*The Adhesiveness of ESSO 50/70 Bitumen Doped with 0.2% A01*

| Storage time of doped bitumen ESSO 50/70 (on 155°C) | The decrease of adhesiveness value (comperison with previous day), [%] |
|---|--|
| after 1 day   | 1.5  |
| after 2 days  | 1.7  |
| after 3 days  | 2.9  |
| after 4 days  | –  |
| after 5 days  | 3.2  |
| after 6 days  | 0.1  |

**Table 2**

*The Adhesiveness of ESSO 50/70 Bitumen Doped with 0.2% A03*

| Storage time of doped bitumen ESSO 50/70 (on 155°C) | The decrease of adhesiveness value (comperison with previous day), [%] |
|---|--|
| after 1 day   | 2.3  |
| after 2 days  | 1.3  |
| after 3 days  | 2.9  |
| after 4 days  | –  |
| after 5 days  | 2.9  |
| after 6 days  | 0.1  |

#### 4. Conclusions

Additives ADETEN type A01 and A02 present a good heat-resisting on a temperature of 155°C (s. Tables 1 and 2).

The A01 and A03 additives have a high stocking stability, a low toxicity degree toward the amine, diamine, polyamine-based additives and are liquid

products perfectly compatible with all bitumines and easy to use.

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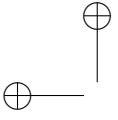
#### STUDII PRIVIND STABILITATEA TERMICĂ A ADITIVILOR DE TIP ADETEN

(Rezumat)

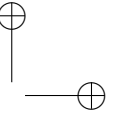
Îmbunătățirea adezivității bitumurile rutiere începe să devină o practică curentă în țara noastră, mai ales atunci când agregatele folosite sunt acide (deci silicioase) sau când se folosesc agregate de râu.

În ultimii ani s-a constatat o tendință pronunțată de a se folosi ca aditivi produși tensio-activi, care ameliorează considerabil adezivitatea acestora față de agregatele naturale. Acest fapt se datorează compoziției și structurii moleculare specifice, polar – apolare, fiind alcătuite dintr-o parte liofilă, care se fixează pe bitum și o parte liofobă, care face legătura cu agregatul natural, indiferent de natura sa mineralogică.

Aditivii ADETEN prezintă o stabilitate ridicată la stocare, un grad scăzut de toxicitate, față de aditivii pe bază de amine, diamine, poliamine și sunt produse lichide perfect compatibile cu toate bitumurile și ușor de utilizat față de aditivii pastă sau solizi, care trebuie aduși în stare lichidă pentru a putea fi folosiți. Totuși, aceștia trebuie să îndeplinească o condiție foarte importantă, pentru a putea fi folosiți ca aditivi pentru bitumuri – stabilitatea termică.

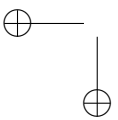


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