

## COMPOSITE MATERIAL FOR ISOLATION OF DEPOTS FOR INDUSTRIAL WASTE AND WASTE OF LIFE

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### ABSTRACT

A new composite material on the base of industrial waste plus additions from inert materials is made. Many laboratory tests are carried out – for defining the convective and diffusion spreading of heavy metals and other harms; the chemical stability to suffosion and the basic mechanical indicators. The material's suitability as an element in the seal depots' stoppings is proved. The possibility of using the new product in building industrial waste depots and depots for waste of life is motivated. Ecological application of waste, polluting the environment, is found out.

### INTRODUCTION

Basic way for decreasing the dangerous effect of waste is their preserving in suitable waste dumps (WD). The seal stoppings of contemporary WD are intended to decrease the waste influence [1]. That's why it is necessary the WS to be treated as very important engineering equipment.

The building of depots for solid waste of life and industrial waste is necessary to be combined with application of reliable bottom and covering seal stoppings which provide minimum movement of harms towards air environment and underground waters and soils. This is underlined in the European conception from 1986 [2] in which the idea of partitioning barriers, is developed in order the waste, put in depots, to be controlled and a monitoring to be realized.

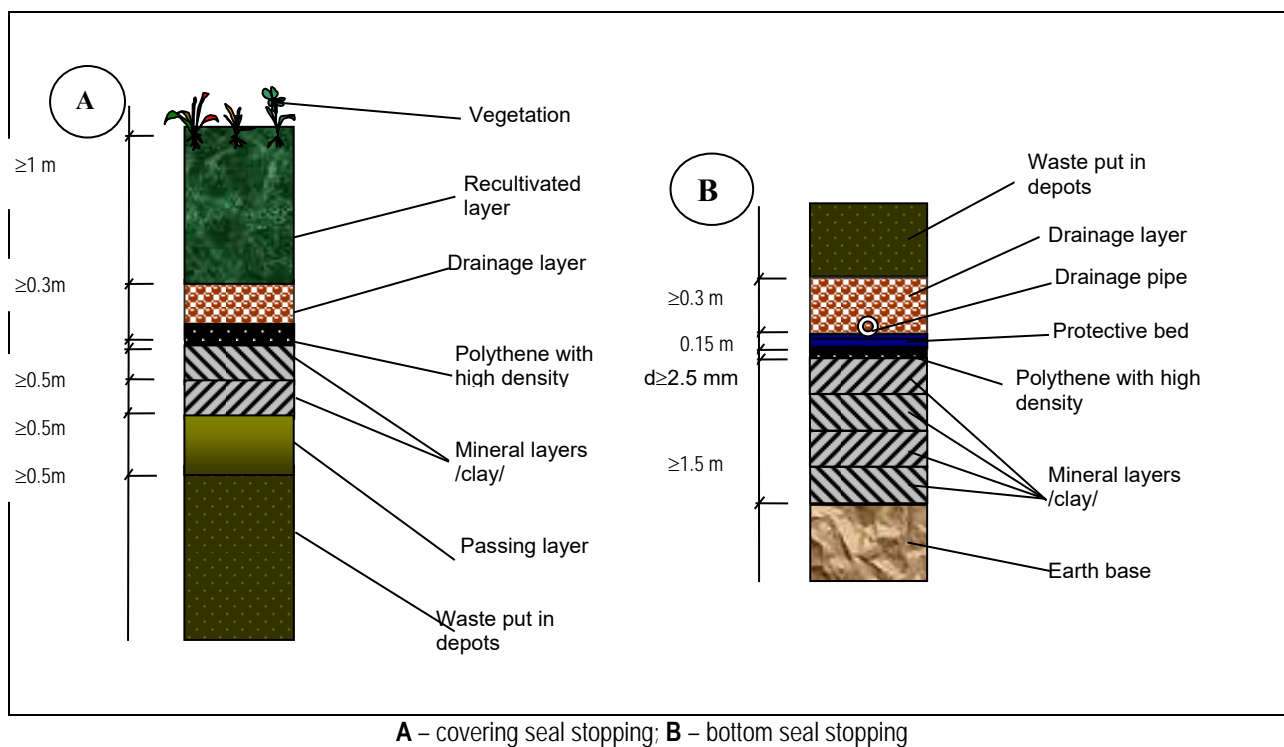


Figure 1. Vertical cuts of seal stoppings used for waste (industrial and of life) putting in depots

The contemporary technical barriers in depots have to be conformed to European standards for firming and seal stoppings. The latter are built from natural and artificial materials. The contemporary construction of bottom and covering seal stoppings contains layers with well-compacted clays with filtration coefficient ( $K_f \leq 1.10^{-9} \div 1.10^{-11}$  m/s), and thickness of 1.5 m and 0.5 m respectively. In the first case clays are with predominant montmorillonite composition, in the second – with caolinite composition, which have the necessary stability to chemical suffusion. The construction of stoppings is shown on fig. 1 [3]. In order to be provided better isolation, high density polythene (HDPE) and polypropylen (PP) in the form of clothes [4] are put.

The type of bottom and covering stoppings must be conformed to the depot class. The depots are classified in three groups according to the quantity of organic hydrocarbons, which are emitted from them and infiltrated by the underground soils and waters [5].

Considerable quantities of high quality clays for mineral layers in the stoppings ( $1 \text{ m}^3 \div 3 \text{ m}^3$  for  $1 \text{ m}^2$  from the area of the depot) and big costs, connected with them, are the reason for searching and creating new materials.

According to German standards [6], using the alternative seal materials is allowed under the condition that they correspond to the criterion for classical ones and have proved qualities, for example, the asphalt concrete, which is a waterproof material. It is suitable for isolation and is applied for many years. As an example it may be given the isolation of more than 20 depots [7] with isolation area of  $203\,600 \text{ m}^2$  in Switzerland. The structure of asphalt concrete is given on fig. 2 [8].

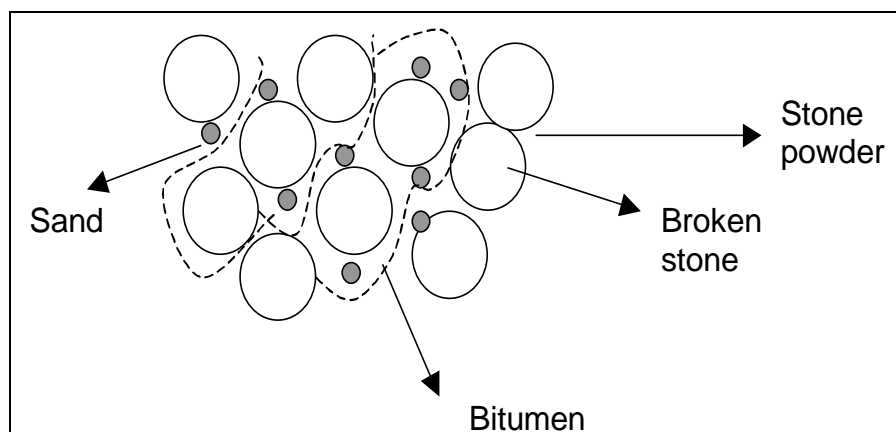


Figure 2. Characterizing scheme of the asphalt concrete

The bitumen and stone powder are put as filler in order to fill the gaps between particles of inert materials. The aim is a dense mass to be formed. It has to be said that the asphalt concrete is good for using under the condition that after compacting the pores is under 3% and the binder is more than 5 weight per cents towards the mass of material. It is necessary the filtration coefficient to be conformed to the European standards and requirements.

#### Material for seal stoppings

The new seal material, called tar concrete, is formed on the base of technological waste from crude oil processing through cracking plus fillers. The waste (tar) has the role of a binder. Its composition is defined through Markuson method (AASHTOT 59/Test methods for emulsified asphalts) and is shown in table №1.

Table 1. Waste composition

Components	Quantity, weight per cents
Water contents	33 % as emulsified water
<b>Contents of dry substance</b>	
A <sub>7</sub> (Asphalts)	14.06 %
Paraffins	36.70%
Resins	49.24 %

Fillers in the new material, which are used for seal layers of the depots, are natural materials. They are shown in table №2 [9].

Table 2. Seal material composition

Composition	Weight per cents, %
Broken stone fraction 5/10	20 ÷ 30
Broken stone fraction 0/5	50 ÷ 60
Bentonite	2 ÷ 5
Stone powder (Si <sub>2</sub> O)	10 ÷ 20
Waste	8 ÷ 11

The ratio between components of crude oil waste, which compose the oil phase of emulsion, are close to those of the distilled bitumen, used in road construction. The high presence of tars is the reason for high stability of the new material to oxydation and photooxydation ageing.

The new material has a filtration coefficient  $K_f = 1.10^{-9} \div 1.10^{-11}$  m/s [10], which is proved for 12 000 minutes. Samples, compacted with static pressure till forming a seal layer with volume density  $\rho = 1.85 \div 2.10 \text{ g/cm}^3$ , show a filtration coefficient  $K_f = 5.10^{-10} \div 5.10^{-11}$  m/s (fig. 3).

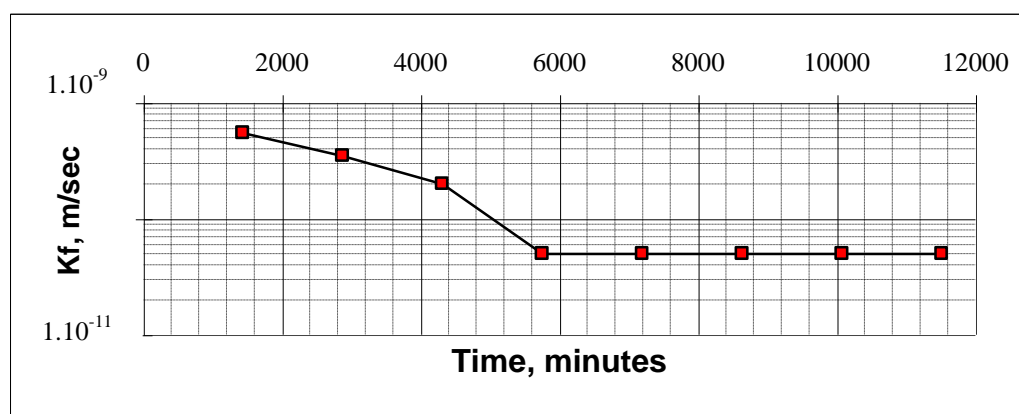


Figure 3. Filtration coefficient of the new material

These values correspond to the requirements, given in "Technische Verordnung über Abfälle".

Tests for defining the diffusion coefficient ( $K_d$ ) are carried out [10]. The values of  $K_d$  are in these limits –  $4.10^{-11} \div 4.8.10^{-11}$  m/s. The results are stabilized and constant after the 50<sup>th</sup> day from the test beginning.

The chemical stability (Fig. №3) of the alternative material to different chemical solutions / Thulol ( $C_7H_8$ ) with purity of 99,5 volume per cents and acid indicator pH - 5,5; NaOH and HCl with pH indicator of 8,0 and 2,0 / was tested in laboratory through the drop method [1]. Chemical reaction of the material with HCl and NaOH was not proved and it kept its stability for a long time. During tests of 720 minutes with thulol in

concentrated form, only surface reaction is indicated. A trace, deep 2÷3 mm and with diameter of 10 mm, is seen. It shows that although the solution aggressiveness the binder is steady in the material and keeps its stability. Putting the inert fillers on silicon base ( $SiO_2$ ) is obligatory. They determine the good chemical stability of the material while the carbonate fillers would react with acids and  $CO_2$  will be formed. Components in binder's composition (asphaltenes, oils and tars) are extremely stable to acids and alkalis. In the waste water from depots of waste of life, presence of thulol may be expected in concentration not higher than ppm (that is thulol, soluble in water in quantity of 515 mg/l at 20 °C). That's why it is possible to say that the new material is stable to the influence of organic solutions [8].

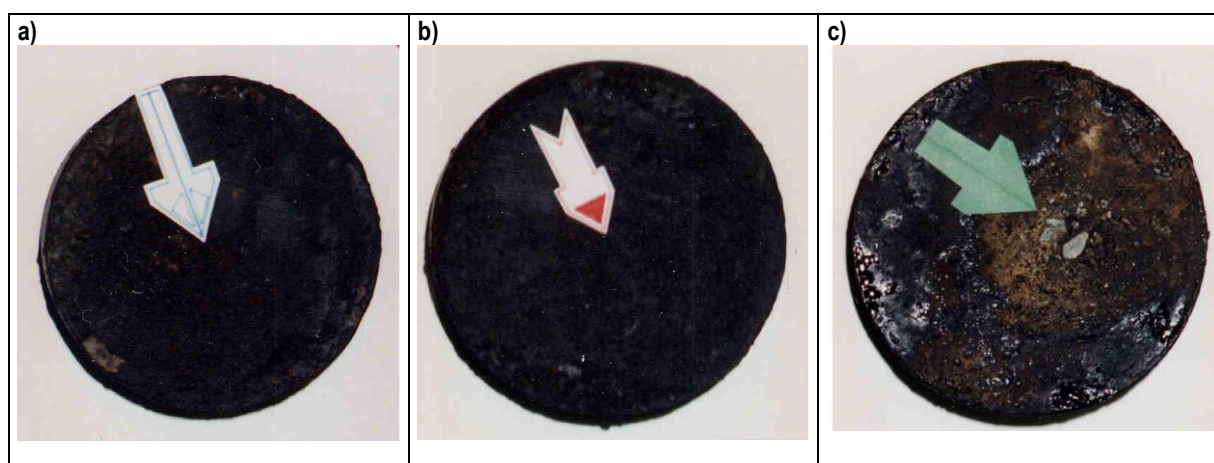


Figure 4. Chemical reaction of the material with: (a) HCl (b) NaOH and (c) Thulol

The composite material bears longitudinal deformation and can undertake considerable vertical bearings up to 0.15 MPa, which are typical for lower seal stoppings.

The technology of preparing and building waterproof and diffusion stable layers from the new material is extremely popular [9]. The homogenized mixture is put still hot on the preliminary leveled and compacted clay or earth base. The spreading is done by machines or by hand and the layer's width is not more than 15cm. The compaction is done through packing until the suitable volume density is reached. The seal stopping is covered with earth mass or clay layer when it cools

down and gets the atmosphere temperature. The composite material stops water and humidity penetration from the underground water in the waste, put in depots, and vice versa, the diffusion process in two directions is practically equal to zero.

## CONCLUSIONS

Using the waste products for economic aims is a real alternative of soils' recovery. With the help of waste, received from the deep processing of crude oil, a seal material, which is

stable to chemical aggression of acids, alkalis and thulol solutions, is prepared. The calculated filtration coefficient of  $5 \cdot 10^{-9} \div 5 \cdot 10^{-11}$  m/s shows that the material is suitable to be used as a seal base in building depots for industrial waste and waste of life. The high strength is another priority. It may be increased through putting geotextile as a structural material because of suitable relations between geotextile fibres and tars from the waste material. The new product is able to form steady waterproof and diffusion resistant covering stoppings. Constructions, which include a layer of tar concrete, are several times cheaper than classical because of considerable reducing the expensive clays; the expensive HDPE - cloth is eliminated; the building time is decreased; the classical road building machines are used.

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