

## **CEMENTATION OF LIQUID RADIOACTIVE WASTE CONTAINING TECHNICAL OILS**

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### **ABSTRACT**

Research works conducted at Moscow SIA "Radon" together with Ecology and Technology Problems Institute have shown that technological process of technical oils cementing can be developed. Contents of oils in cement compound can be up to 15-25 %. To increase the efficiency of technological process of oils cementing it is proposed a complex decision. The report represents results of laboratory investigations.

### **INTRODUCTION**

Wastes containing technical oils are considerable problem. Oils can often be in repositories together with salt LRW, ion exchange resins, silicon lubricants and other wastes. Incineration of such wastes causes serious technological problem by many reasons. The simplest decision is their inclusion into a cement compound at cementing liquid salt radioactive waste.

Disadvantages of traditional cementing of technical oils and LRW:

- low contents of oils (about 4-6 wt.%) in cement grout depending on LRW salinity;
- low (not more than 0,5) solution-cement ratio;
- worsening of cement compound properties;
- uneven distribution of oils in cement compound, which causes local decrease of its properties lower than determined values and degradation;
- settling of oils during cement compound tempering;
- mixing of cement grout requires a special mixer because of cement grout stratification;
- depending on type and state of waste it is possible air-inclusion at mixing cement grout and hence, worsening all regulated properties of the final product;
- high viscosity of cement grout as a result of low solution-cement ratios;
- biological oxidation and saponification of oils in cement matrix with its following degradation by oxidation products and products of microorganisms metabolism.

### **Main Results**

The method offered for cementation of radioactive oil consists in the following. Stable to stratification a suspension is prepared on the base of oils and salt LRW. This suspension is introduced into the main cement grout, which allows evenly distributing oils in hardened cement compound. To increase the degree of oils inclusion into the final product special powder-like additives should be introduced in suspension. These additives are able adsorbing oils and increasing the cement compound quality. As powder-like additives into suspension it is proposed to introduce a complex additive "Bison". Complex additive "Bison" contains

bentonite, which is able to adsorb oils and decreases its contents in liquid phase, ultra fine high mark quickly hardening cement, which improves all properties of the final cement compound as well as biocide additives providing microbiological protection of compound, which is important for long term storage [1,2,3]. Results of laboratory researches are submitted in Table I.

**Table I. Influence of the Additive "BISON" on Properties Cement Compounds with Radioactive Oil**

Water/ Cement ratio	Oil, wt. %	Binding + Binding in Suspension, wt. %	Properties of Grout		Compressive Strength, MPa		
			Floatability, mm	Settling, %	7 days	28 days	56 days
0,7	5	TM <sup>a</sup>	>240	0	3.4	5.8	7.3
		PC+30%PC	>240	0	3.6	6.1	7.9
		PC <sup>b</sup> +30%BIS <sup>b</sup>	215	0	3.7	8.6	10.8
		70% BIS+30%BIS	120	0	5.0	10.6	11.0
	10	TM	>240	2.5	1.2	2.5	2.9
		PC+30%BIS	190	0	2.0	5.1	5.4
		70% BIS+30%BIS	115	0	6.7	7.6	9.8
	15	TM	>240	7	1.1	1.4	1.6
		PC+30%BIS	187	0	1.0	3.8	3.1
		70% BIS+30%BIS	110	0	1.7	4.9	5.1
	20	TM	240	16	-	0.6	0.3
		PC+30%BIS	120	0.2	0.6	1.1	1.6
70% BIS+30%BIS		<100	0	1.9	3.6	3.8	
0,5	15	TM	185	1.2	1.4	1.3	2.0
		PC+10%BIS	179	0	1.5	3.7	5.3
		70% BIS+30%BIS	<100	0	4.3	5.4	6.5

<sup>a</sup> Traditional mixing without preliminary suspension.

<sup>b</sup> PC – Portland Cement, BIS – “Bison”.

Additionally in order to increase stability of suspension, its homogeneity and improving properties of cement compound the suspension should be treated in a vortical apparatus before introducing into the main mixer. Vortical apparatus should be used at the final stage of suspension preparation for its mechanical and magnetic treatment before introduction into the main mixer. Preliminary results have shown that to improve properties of cement compound the suspension should be treated in the vertical apparatus not less than 15-20 seconds.

Results of laboratory researches are submitted in Table II.

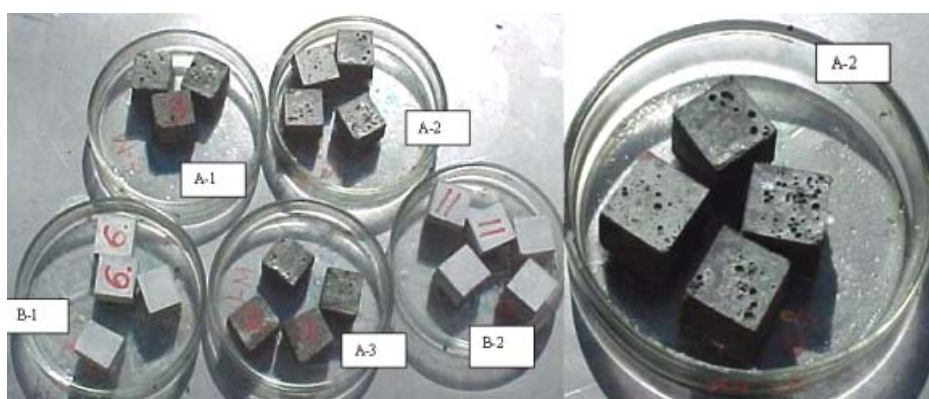
**Table II. Influence of Vortical Processing on Properties Cement Compounds with Radioactive Oil**

Oil,	Processing	Properties of Grout	Compressive Strength, MPa [4]
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wt. %	Time, sec	Floatability, mm	Settling, %	7 days	28 days	56 days	after 30 cycles of freezing - thawing	after immersed in water for 90 days
0	- <sup>a</sup>	>240	3	7.6	11.3	11.4	15.5	11.8
	30	>240	0	16.0	25.8	32.4	21.3	30.8
5	-	>240	3	3.8	4.5	3.0	7.0	7.0
	30	193	0	5.3	11.4	20.9	10.0	9.0
10	-	>240	5	1.2	2.5	2.9	0.9	2.8
	30	183	0	3.9	11.0	6.7	8.4	13.4
15	-	>240	7	1.1	1.4	1.6	0.8	1.7
	30	152	2	2.1	5.6	6.2	4.9	5.4
20	-	230	16	-	-	0.8	0.5	4.3
	30	110	1	1.9	5.2	6.8	5.0	4.9
25	-	211	0	-	-	0.9	0.4	0.6
	30	103	0	1.3	3.2	2.4	1.7	2.0

<sup>a</sup> Traditional mixing without preliminary suspension.

Oil in structure of cement is nutrient for development of bacteria. Gaseous products of activity of bacteria and also organic acids and aldehydes promote increasing of porosity cement compound and can lead to destruction it at long storage. On the preliminary data biocide additive of a polyhexamethylenguanidine class (PHMG) included in "Bison" can give protection from biodestruction (Figure 1) preventing biogenic gas formation.



**Fig. 1. The cement samples, containing 5-15 % of oil, after 5 months of storage: A-1,2,3 - porous samples without biocide additive; B-1,2 - with biocide additive.**

## CONCLUSION

Preliminary researches have shown an opportunity of inclusion of oil in cement compound up to 15-20 %. Now researches proceed.

## REFERENCES

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