

# 渣油-水乳化液作为路面抑尘剂的研究\*

吴 超 孟廷让 王坪龙 王海宁

(中南工业大学资源开发工程系, 长沙 410083)

**摘要** 为了有效抑制汽车运输路面的扬尘, 选择低浓度渣油-水乳化液作为抑尘剂, 通过在实验室大量的试验, 掌握了一组渣油乳化的最佳配方及其制备工艺, 即渣油 3%—6%, 乳化剂约 0.5%, 水 93.5%—96.5%, 制备温度  $>70^{\circ}\text{C}$ 。经过室内和现场大规模试验表明, 当路面喷洒量达到  $2.2\text{ kg/m}^2$  时, 其有效抑尘时间达到 10 d 以上, 并且在一定程度起到养路的作用, 长期使用可取得显著的综合经济效益。

**关键词** 路面防尘, 渣油-水乳化液, 实验室试验, 现场试验。

研究开发一种专用于路面扬尘防治的抑尘剂及其技术具有十分重要的意义, 这种技术也可广泛推广应用到城市公路建设的路面防尘等领域。经过比较数 10 种抑尘材料<sup>[1-5]</sup>, 笔者选择渣油或软质沥青作为抑尘剂基料。

## 1 渣油-水乳化液的制备方法及其性能

### 1.1 制备方法

经过大量的实验室试验取得了一种最佳的配方, 即渣油 3%—6%, 水 93.5%—96.5%, 乳化剂大约 0.5%, 其中乳化剂由十二烷基硫酸钠和月桂醇 2 种表面活性剂组成, 实验中也使用了非离子表面活性剂。该配方可以取得理想的乳化效果。其乳化工艺为: 首先用蒸汽把渣油预热到软点, 然后加入一种表面活性剂并搅拌; 同时, 用蒸汽加热水温到  $>80^{\circ}\text{C}$ , 并把另一种表面活性剂放入水中并搅匀。之后, 分别将加有表面活性剂的软化渣油和热水放到搅拌桶中用搅拌机搅拌数分钟。制备好的分散相乳液可在常温状态保持 24 h 不分层。

### 1.2 乳化液蒸发量与时间的关系

实验结果见图 1。

从图 1 可以看出, 乳化液的耐蒸发性随温度的升高明显优于盐水溶液。当蒸发温度为  $25^{\circ}\text{C}$  时, 10%  $\text{MgCl}_2$  溶液的耐蒸发性与油浓度为 2%、3%、4% 的乳液的比较接近; 而当温

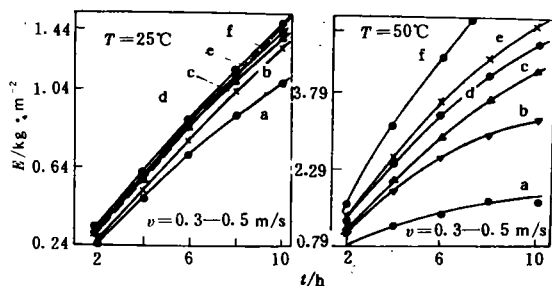


图 1 乳化液蒸发量与时间的关系

a. 10%渣油乳液 b. 5%渣油乳液 c. 4%渣油乳液  
d. 3%渣油乳液 e. 2%渣油乳液 f. 10%  $\text{MgCl}_2$  溶液

度  $50^{\circ}\text{C}$  时, 油浓度为 2% 的乳液的耐蒸发性就明显优于 10%  $\text{MgCl}_2$  溶液。由于盐水溶液耐蒸发性都优于纯水, 而  $\text{MgCl}_2$  溶液为最好。可见, 渣油-水体系乳化液的耐蒸发性好。

### 1.3 乳化液蒸发量与油浓度的关系

实验结果见图 2。

从图 2 可以看出, 当蒸发温度为  $50^{\circ}\text{C}$ , 油浓度为 10% 的乳化液 10 h 小时内蒸发量低于 5% 乳化液 4 h 内的蒸发量; 且当温度低时, 乳化液蒸发量受油浓度的影响小, 因为温度低时, 乳化液表面成膜程度相近, 因而抗蒸发性也相近; 当温度高时, 乳化液中油浓度越大, 则成膜

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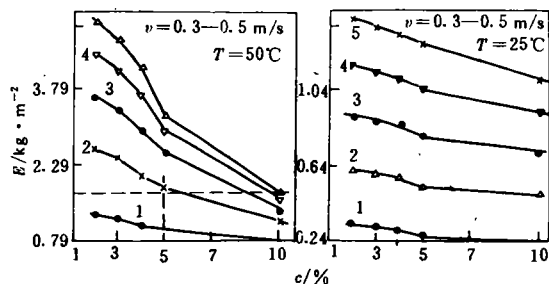


图2 乳化液蒸发量与油浓度的关系

1.  $t=2\text{ h}$  2.  $t=4\text{ h}$  3.  $t=6\text{ h}$  4.  $t=8\text{ h}$  5.  $t=10\text{ h}$ 

越厚,耐蒸发性越好.从图2还可以看出,当渣油浓度小于5%时,蒸发量与油浓度关系很大;当渣油浓度大于5%时,浓度对蒸发量也有影响,但没有小于5%时那么明显,蒸发时间越长,蒸发温度越高,渣油浓度对乳化液的蒸发量影响越大.另外,当温度低时,各种浓度的乳化液蒸发量与时间之间几乎成直线关系.可见,乳化液喷洒后,成膜的厚薄影响水分的蒸发.

#### 1.4 乳化液蒸发率与油浓度的关系

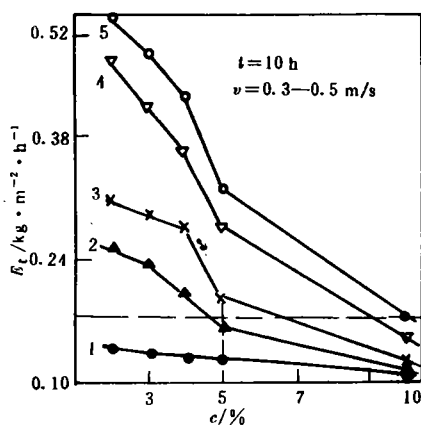


图3 乳化液蒸发率与油浓度的关系

1.  $t=25^\circ\text{C}$  2.  $t=30^\circ\text{C}$  3.  $t=35^\circ\text{C}$   
4.  $t=40^\circ\text{C}$  5.  $t=50^\circ\text{C}$ 

结果见图3.从图3可以看出,当油浓度 $>5\%$ 时,乳化液的蒸发率随浓度增大的变化幅度小,而 $<5\%$ 时则相反;乳化液的蒸发率随温度的升高而增大,当浓度为10%、 $50^\circ\text{C}$ 时,10 h内的蒸发率与浓度为5%,温度为 $30^\circ\text{C}$ 、10 h内的蒸发率接近,而低于 $35^\circ\text{C}$ 、 $40^\circ\text{C}$ 时的蒸发率;当温度为 $25^\circ\text{C}$ 时,渣油浓度对蒸发率的影

响没有其它温度时明显.可见,浓度越大,乳化液的蒸发率越小.

#### 1.5 乳化液蒸发率与温度的关系

结果见图4.

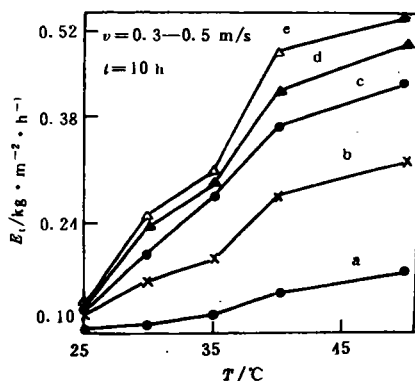


图4 乳化液蒸发率与温度的关系

a. 10%渣油乳液 b. 5%渣油乳液 c. 4%渣油乳液  
d. 3%渣油乳液 e. 2%渣油乳液

综上分析可知,在气温较低地区或在冬季可选浓度低一些的乳化液抑尘,这样可以节省抑尘费用.而在温度较高地区或夏季则宜选择浓度大一些乳化液抑尘,以便能有效抑制粉尘.当然,在选择乳化液油浓度时还应考虑路面质量及产生情况.

## 2 现场应用实践

### 2.1 乳化液制备站的建设

1992年笔者在某矿露天矿工区建造了一个抑尘乳化液制备站,其示意图如图5所示.

### 2.2 现场试验结果

在土路、碎石路、水泥路分别做了大量的现场试验.为了测定汽车过后路面上的呼吸性粉尘浓度,采用重力采样法测尘.经过大量的测尘工作,获得了足够的测尘数据.表1列出了部分测定结果,图6给出了不同喷洒强度路面平均粉尘浓度与有效抑尘时间的关系.可看出,抑尘的有效时间随喷洒的次数增加而增长.连续喷洒4次后,有效抑尘时间可达7 d,此时最高粉尘浓度仍满足允许值.

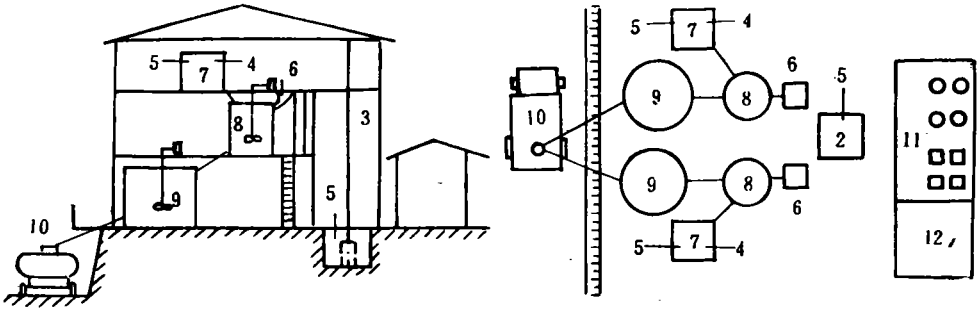


图5 乳液制备站系统

1. 渣油桶 2. 预热油槽 3. 提升机 4. 水源 5. 蒸汽源 6. 渣油漏斗 7. 水箱  
8. 一级搅拌桶 9. 二级搅拌桶 10. 洒液卡车 11. 材料室 12. 休息室

表1 使用乳化液后的部分现场试验结果<sup>1)</sup>

喷洒次数	喷洒量 /kg·m <sup>-2</sup>	距喷洒后 测定时间 /d	过车数	粉尘浓度/mg·m <sup>-3</sup>					
				A	B	C	D	E	平均
0	0		8	28.7	26.6	26.8	22.1	16.2	24.08
1	0.67	1	7	2.2	2.7	2.6	1.2	1.1	2.16
2	0.67	2.5	7	8.9	9.0	8.7	8.0	7.5	8.4
3	0.40	3.5	9	8.3	8.1	8.6	7.2	7.1	7.9
4	0.40	1	9	1.9	2.1	2.0	0.9	0.5	1.5
停止喷洒		1	8	2.8	2.3	2.5	1.5	1.0	2.0
		2	10	3.9	4.2	4.6	1.8	2.0	3.3
		3	7	5.9	6.2	5.5	4.0	4.1	5.1
		4	6	6.3	6.0	5.8	4.3	5.0	5.5
继续观测		5	9	6.8	6.5	6.0	5.1	5.4	6.0
		6	7	8.1	8.6	7.2	7.0	6.8	7.5
		7	8	9.5	9.0	8.9	8.4	8.0	8.8

1) A、B、C、D、E为不同测尘点；气温20—30℃；风速2—3 m/s；相对湿度50%—70%；晴天。

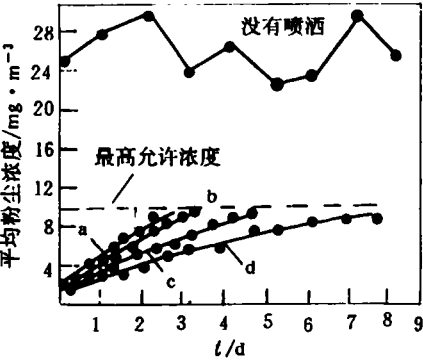


图6 不同洒液量碎石路边上过车时平均  
粉尘浓度与有效抑尘时间的关系  
a. 0.67 kg/m<sup>2</sup> b. 1.34 kg/m<sup>2</sup>  
c. 1.74 kg/m<sup>2</sup> d. 2.14 kg/m<sup>2</sup>

3 结语

(1) 在达到同样防尘效果的前提下，如果用

洒水防尘的方法，除了必须购置使用大量的洒水车外，同时开车司机工资、油费、洒水车折旧维修费、洒水用量等将大大增加。

(2) 在汽车运输路面上频繁用洒水车洒水不仅影响正常的生产运输，且而会破坏路面；而使用喷洒乳化液的方法，与水相同的喷洒量其有效作用时间却可以比水长几十倍到几百倍，长期使用还起到养路护路的作用。

(3) 用乳化液护路防尘可以减少卡车维修工作量，延长汽车大修期限，节省油耗，提高道路通过能力，从而达到降低综合运输成本的目的。

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creasing with reaction time under conditions of 0.85 MPa and 900°C, and the conversion rate is in range of 23.5% to 42% at 120 minutes. The conversion rate is drastically growing with temperature under conditions of 1.15 MPa and 750–950°C at 120 minutes. The conversion rate was slowly and linearly increasing with pressure under condition of 860°C. Finally, the reaction mechanism was discussed.

**Key words:** pressurized thermogravimetric analysis, limestone, dolomite, desulfurization.

**Study on the Regeneration of  $\text{NaHSO}_3$  in the Recovery of  $\text{SO}_2$  from Flue Gas by Bipolar Membrane Electrodialysis.** Yu Lixin et al. (Department of Chemical Engineering, Tsinghua University, Beijing 100084); *Chin. J. Environ. Sci.*, 17(6), 1996, pp. 40–42

Bipolar membrane electrodialysis is adopted in the regeneration of  $\text{NaHSO}_3$ , which is used as absorbent of  $\text{SO}_2$  from flue gas. When cation-exchange membrane is supplemented with , both homogeneous and heterogeneous bipolar membranes which are made in our lab and by Shanghai Chemical Factory, respectively, can produce satisfactory conversion ratio (higher than 80%) in the regeneration process. The decrease of current efficiency (from approximately 80% to approximately 20%) is resulted from the increase of the concentration of proton in acid chamber. The existence of small amount of  $\text{Na}_2\text{SO}_4$  in  $\text{NaHSO}_3$  solution doesn't cause much effect on regeneration process. The short membrane lifetime hinders the process from getting into practical application.

**Key words:** bipolar membrane electrodialysis, recovery of  $\text{SO}_2$  from flue gas, regeneration of  $\text{NaHSO}_3$ .

**Study on Characterization of Adsorption of Zinc onto five types of soil in Beijing Area.** Zhou Wei and Li Jiyun (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085); *Chin. J. Environ. Sci.*, 17(6), 1996, pp. 43–45

The results of study on adsorption of zinc onto five types of soil in Beijing area showed that the capacity of five types of soil adsorbing zinc presents positive correlation with pH value of the soil solution, contents of organism and  $\text{CaCO}_3$  etc in soil. The adsorption data could be fitted to the Freundlich-type equation.

**Key words:** adsorption, zinc, soil, Beijing area.

**A Study on Acclimation Technique of Activated sludge and Biological Treatment of High Consistence Cheni-thermomechanical Pulp Wastewater.** Chen Min (Guangdong University of Technology, Environment & Resource Engineering Department, Guangzhou, 510090), Sung-Nien Lo and H-Claude Lavallée (Université du Québec à Trois-Rivières, Québec, Canada, G9A 5H7); *Chin. J. Environ. Sci.*, 17(6), 1996, pp. 46–49

The treatment of high consistence Cheni-thermomechanical Pulp (CTMP) pulping wastewater using activated sludge method was studied in this paper. The effect of improving technique in activated sludge acclimation on the sludge settleability and removal efficiencies was discussed. The Experiments showed that the improved technique i. e

combination of batch and continous feed in sludge acclimation process can remarkably improve the sludge settleability and removal efficiencies. The sludge volume after 30 minutes of settling was 290–320 ml/L, sludge volume index was 48–55 ml/g, the removal of COD reached to 77%–85%, removal of  $\text{BOD}_5$  was 90%–95%, removal of TSS was 75%–89%.

**Key words:** batch feed, continous feed, activated sludge, acclimation technique, CTMP wastewater.

**Test of Tar Emulsified Liquid as Dust Suppressant for Dirt Roads.** Wu Chao et al. (Dept. of Resources Exploitation Engineering, Central South University of Technology, Changsha 410083); *Chin. J. Environ. Sci.*, 17(6), 1996, pp. 50–52

In order to control the dust raising on the dirt roads efficiently, the tar emulsified liquid with low concentration was taken as the dust suppressant. Based on a great number of experiments in laboratory, the optimum compositions of surfactants and the prepared condition for emulsifying tar were achieved, tar is 3%–6%, surfactants is 0.5% and water is 93.5%–96.5 Wt. %. The prepared temperature is greater than 70°C. Depended on a lot of tests both in laboratory and field, the results showed that the liquid is very efficient for binding dust and maintaining the dirt roads. The active time can reach more than 10 days, when the liquid is sprinkled on the road in 2.2 kg/m<sup>2</sup>. A rational profit can also be achieved after it is used for years.

**Key words:** dust suppressant for roadway, tar emulsified liquid, field test.

**Electrochemical Separation Process for Recovery of Gold, Silver and Lead from Scrap.** Liang Huqi et al. (Dept. of Chem. Eng., Shanghai University, 200072); *Chin. J. Environ. Sci.*, 17(6), 1996, pp. 53–56

The electrochemical separation process for comprehensive recovery of gold, silver and lead from Au, Ag-containing scrap was investigated. The smooth and dense cathodic deposit with purity of 99% Pb was prepared by electrochemical separation process under the optimum technological conditions (electrolyte composition: 70 g/L  $\text{Pb}^{2+}$ , 100 g/L total  $\text{SiF}_6^{2-}$ ; solution temperature: 40°C. current density: 100 A/m<sup>2</sup>; concentration of  $\beta$ -naphthol to bone glue: 0.002 g/L and 0.5 g/L) experimentally. The current efficiency of lead was higher than 98%, the specific electric energy consumption was 117 kW · h/tPb. The recovery of Au and Ag in the anode slime were as high as 99% and 98% respectively.

**Key words:** recovery of Au and Ag, electrochemical separation, treatment of scrap.

**Effects of Low pH Value and Aluminum on Uptake of  $^{45}\text{Ca}$  by *Misgurnus anguillicaudatus*.** Kong Fanxiang et al. (Dept. of Environ. Sci. and Eng., Nanjing University, Nanjing 210093); *Chin. J. Environ. Sci.*, 17(6), 1996, pp. 57–59

The effects of low pH value and with or without the addition of aluminum on the uptake of  $^{45}\text{Ca}$  by *Misgurnus anguillicaudatus* were studied. The results showed that