The Optimal Preparation of Scale Inhibitor Polyaspartic Acid

JING Guo-lin, ZHAO Hai, WANG Xiao-yu
(College of Chemistry and Chemical Engineering, Daqing Petroleum Institute, Daqing 163318, China)

Abstract: Polyaspartic acid (PASP) was prepared by the means of polymerizing maleic anhydride and ammonia solution. In order to find optimal condition of synthesizing PASP, we made a set of experiments on proportion of material, temperature and time of polymerization in the single condition, and compared PASP with other scale inhibitors about the performance of scale inhibition and biodegradation. The results show: the optimal proportion of material is 1∶1.1, the temperature of polymerization is 160℃, and the time of polymerization is 1 h. Under above condition, we synthetized the PASP its inhibiting efficiency can reach over 95%, and biodegradation rate reaches 70%.

Key words: polyaspartic acid; maleic anhydride; green scale inhibitor; biodegradation
CLC number: TQ085 Document code: A Article ID: 0529-6579 (2007) Sl-0248-02

At present scale inhibitors in common use include inorganic polyphosphates, phosphorus-containing scale inhibitors, low-molecular-weight polymer, natural scale inhibitors and so on[1]. Non-phosphorus green scale inhibitors have been developed since 1990 overseas, which indicates green scale inhibitors have became one of developmental aspects in water treatment medicaments[2-4].

1 Experimental method

1.1 Synthetic Method

Maleic anhydride and ammonia were mixed in agitating condition for obtaining clear homogeneous solution. Polymerize the solution under different temperature and time to get a kind of production, polysuccinimide (PSI). Then PSI was hydrolyzed with NaOH solution to get sodium salt polyaspartic acid.

1.2 performance evaluation

The molecular weight values of PASP, scale inhibition performance and biodegradation were respectively measured and analyzed by using viscometry[5], static anti-scaling method and shaking-bottle incubating test[6].

2 Results and discussion

2.1 Optimization of synthesis reaction condition

According to the method of 1.1, We made a set of tests about optimization of synthesis reaction condition.

(1) The choice for mol ratio of material: the materials with different mol ratios were polymerized for 2 hours under 160℃ respectively. The experimental results showed: when mol ratios of material were 1∶1.1, 1∶1.2, 1∶1.3, 1∶1.4, 1∶1.5, performance of productions had a little difference; the materials could not be reacted completely when mol ratio was 1∶2; they were not nearly polymerized when mol ratio was over 1∶3. thus it can be seen that the polymerization with lower ratio is more easily, but corresponding molecular weight value are not very large. At last we confirm the optimal mol ratio of material is 1∶1.1.

(2) The choice for Polymerization temperature: the experiments were progressed for 2 hours under different temperatures and mol ratio 1∶1.1. The results showed: molecular weight value went more weighty evidently with higher temperature, but Inhibiting efficiency fell off with larger molecular weight value. Therefore polymerization temperature with optimal scale inhibiton performance is 160℃.

(3) The choice for polymerization time: polymerization time was studied under 160℃ and mol ratio 1∶1.1. We can see from the results the molecular weight value was increased revidently with longer polymeration time, but Inhibiting efficiency fell off with higher molecular weight value. At last we confirm polymerization time is 1 h.

①收稿日期: 2007-01-10
基金项目: 黑龙江省教育厅科学技术研究项目资助 (10551006)
作者简介: 荆国林 (1969年生), 男, 博士, 副教授; E-mail: jglhgd@163.com

2.2 Biodegradation and scale inhibition performance

According to the method of 1.2, we evaluated the performance of PASP which was synthetized under the optimal reaction conditions; the results were shown in fig 1.

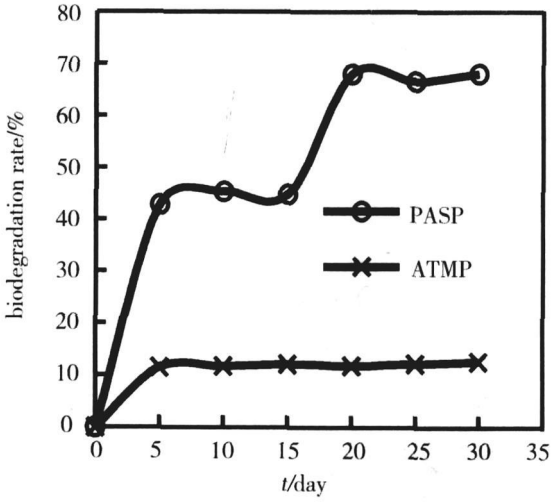

Fig 1　compare of biodegradation for PASP and ATMP

The results show PASP can get the same effect with phosphorous scale inhibitor, its inhibiting efficiency can reach over 95%. It is found from Fig 1 indicates that PASP has better biodegradation performance, the highest biodegradation rate can reach 70%, which is evidently higher than that of phosphorous scale inhibitor, ATMP.

3 Conclusions

(1) The optimal conditions of polyaspartic acid (PASP) fluid polymerization is: mol ratio of materials is 1∶1.1; polymerization temperature is 160℃; polymerization time is 1 h. Under above conditions, PASP has the best performance.

(2) PASP can get the same effect with phosphorous scale inhibitor. Biodegradation rate can reach 70%, which is evidently higher than that of phosphorous scale inhibitor, ATMP.

References:

[1] LU Z, ZHENG S Z, QIAN Z N, et al. Water Treatment Technology in Oilfield [M]. Beijing: Oil Industry Publishing Company, 1990.

[2] JING G L, YU S L, LIU S Z. Progress in the green scale inhibitor polyaspartic acid [J]. Industrail Water Treatment, 2003, 23 (11): 1—4.

[3] LOW K C, WHEELER A P, KOSKAN L P. Green Chemistry Applied to corrosion and Scale Inhibiors [J]. Ady. Chem. Ser., 1996, 248 (2): 99—111.

[4] ROSS R J, LOW K C, SHANNON J E. Green Chemistry Applied to Corrosion and Scale Inhibitors [J]. Material Performance, 1997, (4): 52—57.

[5] XU Y J, YANG W Z. Performance of scale-corrosion inhibition of polyaspartic acid [J]. Nanjing University of Technology, 2002, 24 (1): 87—89.

[6] HUANG Y X, LEI Z F. Study on the biodegradability of polyaspartic acid by shaking-bottle incubating test [J]. Industrial Water Treament, 2003, 23 (12): 26—28.

绿色阻垢剂聚天冬氨酸的优化制备

荆国林，赵　海，王晓玉

(大庆石油学院 化学化工学院，黑龙江 大庆 163318)

摘　要：以马来酸酐为原料制备聚天冬氨酸，并对聚合反应的质量配比、聚合温度和聚合时间三个反应条件进行了优化实验，对最优条件下合成的 PASP与其它阻垢剂进行了性能对比。结果表明：合成 PASP的最佳条件是：原料质量配比为 1∶1.1，聚合温度为 160℃，聚合时间为 1 h，阻垢率可以达到 95%以上，生物降解性能达到 70%。

关键词：聚天冬氨酸；马来酸酐；绿色阻垢剂；生物降解

中图分类号：TQ085