带式压滤机脱水系统加药自动控制*

田秀敏 刘开连 黎 琦 马殿旗 楼上游 胡仕明

(机械工业部机械科学研究院环保所，北京 100044)

摘要 通过实验确定了污泥脱水化学调节过程中投加药量和污泥浓度之间的关系，建立了加药自动控制数学模型. 在唐山西郊污水处理厂2 m带式压滤机脱水系统中，通过在线测量污泥瞬时浓度和流量实现投药自动控制，使带式压滤机长期正常运转，改善机械脱水效果，平均节约用药量15%.

关键词 污泥脱水，化学调节，带式压滤机，加药自动控制.

采用带式压滤机进行污泥脱水时，需首先进行化学调节，加入有机高分子絮凝剂，使污泥形成絮团，才能有效地进行固液分离[1,2]. 我国的有关研究和应用仅限于絮凝机理、絮凝剂筛选及使用. 国外从80年代末开始进行化学调节在线控制研究[3-5]，以实现机械脱水最佳效果，减少絮凝剂的过量投放. 笔者所在单位积多年研究经验，开发了污泥浓度在线测量仪表及带式压滤机脱水成套设备. 发明了带式压滤机脱水自动系统，并在唐山建立了示范工程. 本文仅就带式压滤机脱水过程中加药的自动控制加以论述.

1 加药自动控制原理及数学模型

污泥絮凝时加药量和污泥种类、处理量及污泥中固体浓度有关. 经实验测定出某种特定污泥的最佳投药量值Y(mg/g)后，投加药量则取决于某时间间隔内污泥中总固体流量(式1)：

$$W_2 = (c_1 \times W_1 \times Y)/c_2 \qquad (1)$$

式中，c_2为药液浓度(%)；c_1为污泥固含量(%)；W_2为药液质量流量(kg/h)；W_1为污泥质量流量(t/h)；Y为最佳用药量(kg/t).

在实际操作中污泥和药液比重近似为1，故

$$W_2 = V_2 \qquad (2)$$

$$W_1 = V_1 \qquad (3)$$

式中，V_2为药液流量(L/h)；V_1为污泥流量(m^3/h). 将式(2)、(3)代入式(1)，得到控制系统模型：

$$V_2 = (Y \times c_1 \times V_1)/c_2 \qquad (4)$$

控制系统原理见图1.

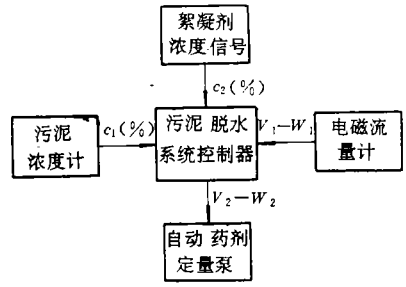

图1 污泥脱水控制系统原理

由在线测量仪表US-1型污泥浓度计测量出污泥瞬时浓度c_1，电磁流量计测量出污泥瞬时流量V_1，将这2个电压信号输入中心控制器，按数学模型处理后，将电压信号输入药剂定量泵的投药量调节计，调节瞬时加药量，实现带式压滤机投药的自动控制.

2 带式压滤机脱水投药自动控制工程

研制的投药自动控制系统应用在一台DY2000型带式压滤机脱水系统中. 该脱水系统流程如图2.

污泥经单螺杆泵输入絮凝反应器，固体絮凝剂经速溶机溶解后，由注塞泵输入絮凝反应器中，与污泥充分反应后，进入2 m带式压滤

* 国家重点企业技术开发项目
收稿日期：1995-12-07

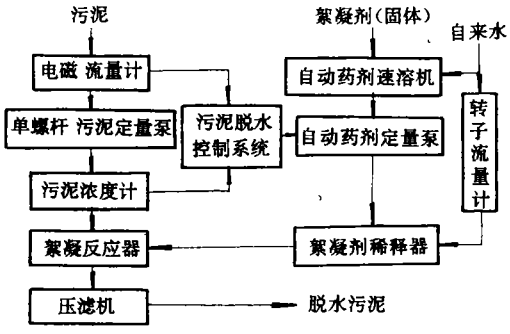

图 2 唐山西郊污水处理厂污泥脱水自动控制流程

机上进行脱水. 该系统每小时处理市政污泥 10—12 m^3，由于使用了投药自动控制，不仅使脱水过程顺利完成，还平均节约用药量 15%.

3 投药自动控制系统运行分析

唐山西郊污水处理厂污泥浓度随时间变化很大(表 1)，用人工很难控制适宜的加药量.

将表 1 所示的时间间隔内污泥浓度随时间的分布代入模型式(4)，求出絮凝剂加药量随时间的分布，如图 3 中实线，图 3 中虚直线是人工控制的最低加药量. 2 线之间的面积为节省用药量. 工程调试和运转数据证实了这种特性.

由于污水厂污泥浓度和流量经常波动，通过在线测量污泥瞬时浓度和瞬时流量使投药实现自动控制后，改善了机械脱水效果，带式压滤机运行正常，不再出现跑泥现象. 根据现场连续运行记录结果，发现运行中有以下几种类型：

表 1 某污水厂污泥浓度现场变化

污泥浓度/%	1.88	1.89	1.84	1.93	2.35	4.37	4.88	2.42	1.32	2.20
时间分布/min	10	20	30	40	50	60	70	80	90	100

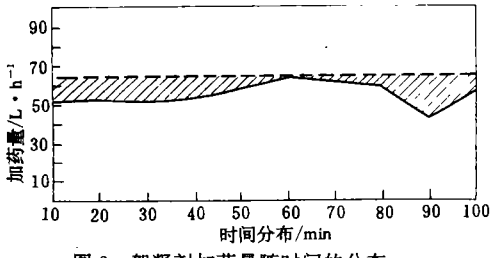

图 3 絮凝剂加药量随时间的分布

(1) 污泥浓度变化幅度大(图 4a)，用人工很难控制加药量，只能加大用药量维持带式压滤机的正常运转. 因而也充分体现了加药自动控制的优点. 用双通道记录仪记录的现场加药情况如图 4，直线和曲线之间的部分是该时间间隔内节约的用药量.

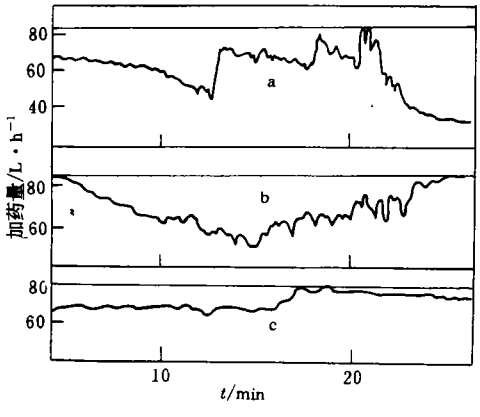

图 4 运转曲线

a. 浓度变化大 b. 低浓度 c. 高浓度

(2) 污泥浓度比较低时(0.5%－2%)，运转时投药记录见图 4b. 絮凝剂架桥交联作用在稀污泥中难以实现，低于 2%浓度的污泥很难脱水. 由于采取了投药自动控制，较好地完成了低浓度下污泥脱水.

(3) 污泥浓度高时的运行记录如图 4c. 经浓缩池充分浓缩后的固含量 2%—4%的污泥是最好处理的稳定污泥，加药量易于控制、脱水效果好和滤饼含水率低.

4 结论

通过对污泥浓度和污泥流量的瞬时在线测量，首次完成了对 2 m 带式压滤机脱水系统投药的自动控制. 该系统不仅使带式机能长期稳定可靠地运转，减轻工人的劳动强度，还较大幅度地节省絮凝剂的用量，降低运转费. 该投药自动控制系统促进了污泥脱水技术的发展.

参 考 文 献

1 Tsang K R et al.. Wat. Sci. Tech., 1990, **22**(12): 135
2 Clarke W N et al.. Wat. Sci. Tech., 1990, **22**(12): 173
3 Campbell H W et al.. Wat. Sci. Tech., 1989, **21**: 1309
4 Crawford. Wat. Sci. Tech., 1990, **22**(18): 261
5 古里明. 计装. 1974, **11**: 38

the U content after purification decreases with decrease of U content in digested solution. The optimum pH for coprecipitation is about 5.8.

Key words: U, $Fe(OH)_3$, coprecipitation, removing uranium.

Study on Correlation Between Influent and Effluent Substrate Concentrations of Biofilm Reactor. Yu Liu (Dept. of Civil and Structural Eng., Hong Kong Univ. of Science and Technology, Hong Kong), Qingliang Zhao (Dept. of Environ. Eng., Harbin Univ. of Architecture and Eng., Harbin 150001): *Chin. J. Environ. Sci.*, **17**(4), 1996, pp. 28—30

This paper mainly investigated the effect of influent substrate concentration (S_0) on steady state effluent quality (S_e) for anaerobic, heterotrophic-aerobic and nitrifying biofilm reactors. It was found that variation pattern of S_e as S_0 changes is subject to a semi-U shaped curve. Based on the known linear model, a nonlinear S_0-S_e model was developed. It was demonstrated that this model can provide a quantitative description for experimental data, also was confirmed by the data from literature. The proposed concept of critical influent substrate concentration has great importance in future design and operation of biofilm reactor.

Key words: biofilm, substrate, reactor, modeling.

Automatic Control of Polymer Addition for Belt Press Sludge Dewatering System. Tian Xiumin et al. (Research Institute of Machinery Seience and Technology, Beijing 100044): *Chin. J. Environ. Sci*, **17**(4), 1996, pp. 31—32

The relation between polymer dosage and sludge concentration had been determined. The model of automatic control for polymer addition was established. The control system was installed on a two-metre belt press dewatering raw sludge of Tangshan Xijiao Sewage Treatment Plant by measuring sludge concentration and flow rate in line. The evaluation was conducted by comparing the results of historical manual operation with those achieved on the same press under automatic control. Analysis of the data indicated that average 15% polymer can be saved, the dewatering effect can be improved and more uniform performance of the dewatering machine will be realized.

Key words: sludge dewatering, belt press, automatic control for dosage.

Photocatalytic Degradation of Organophosphorus Pesticides Using TiO_2 Supported on Fiberglass. Chen Shifu et al. (Dept. of Chem. Eng., Zhengzhou Institute of Technology, Zhengzhou 450002): *Chin. J. Environ, Sci.* **17**(4), 1996, pp. 33—35

Photocatalytic degradation of organophosphorus pesticides using supported TiO_2 as a catalyst, which is prepared by thermal decomposition and calcination of colloidal solution made from hydrolytic of titanium tetraisopropoxide [$Ti(iso\text{-}OC_3H_7)_4$] on fiberglass was studied. The results showed that four organophosphorus pesticides of lower concentrations were completely photocatalytically degraded into PO_4^{3-} within a short time illumination with a medium pressure mercury lamp of 375 W. The TiO_2 supported on the fiberglass was not removed easily, after 120 h illumination there was no significant loss of the photocatalytic activity of TiO_2, it could be used continually. The reasons of the different chemical structures of organophosphorus pesticides affecting photodegradation efficiency were investigated.

Key words: supported TiO_2, photocatalytic degradation, organophosphorus pesticides, titanium tetraisopropoxide.

Ecological Effects of Multi-Effects-Triazole on Soil Microbe. Gong Ping (Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang 110015), G. Beudert (Institute for Aquatic Environmental Engineering, University of Karlsruhe, D-76128 Karlsruhe, F. R. Germany): *Chin. J. Environ. Sci.*, **17**(4), 1996, pp. 36—38

Effects of multi-effects-triazole (MET) on soil nitrification, dehydrogenase activity (DHA), respiration and microbial biomass C were investigated through laboratory incubation and field experiments. It is derived from this study that MET has no adverse long-term influence on soil microbe. However, its short-term effects are notable and need further studies.

Key words: multi-effects-triazole (MET), soil microorganism, ecological effects.

An Interaction between *Scenedesmus obliquus* and N-(2, 4-dimethylphenyl)-N′-methylformamidine. Yan Hai et al. (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085): *Chin. J. Environ.*