Article

A Non-Contact Original-State Online Real-Time Monitoring Method for Complex Liquids in Industrial Processes

Ning Duan, Linhua. Jiang, Fuyuan Xu, Ge Zhang

PII: S2095-8099(17)30782-8
DOI: https://doi.org/10.1016/j.eng.2018.05.005
Reference: ENG 70

To appear in: *Engineering*

Received Date: 15 December 2017
Revised Date: 8 March 2018
Accepted Date: 10 May 2018

Please cite this article as: N. Duan, Linhua. Jiang, F. Xu, G. Zhang, A Non-Contact Original-State Online Real-Time Monitoring Method for Complex Liquids in Industrial Processes, *Engineering* (2018), doi: https://doi.org/10.1016/j.eng.2018.05.005

Engineering 4 (2018)

Research
Green Industrial Processes—Article

A Non-Contact Original-State Online Real-Time Monitoring Method for Complex Liquids in Industrial Processes

Ning Duan *, Linhua. Jiang, Fuyuan Xu, Ge Zhang
Center for Heavy Metal Cleaner Production Engineering Technology, Chinese Research Academy of Environmental Sciences, Beijing 100012, China

* Corresponding author.
E-mail address: ningduan@craes.org.cn (N. Duan).

ARTICLE INFO
Article history:
Received 15 December 2017
Revised 8 March 2018
Accepted 10 May 2018
Available online

Keywords:
Complex liquid
Original-state monitoring
Online real-time
Non-contact identification

ABSTRACT
Failures are very common during the online real-time monitoring of large quantities of complex liquids in industrial processes, and can result in excessive resource consumption and pollution. In this study, we introduce a monitoring method capable of non-contact original-state online real-time monitoring for strongly coated, high-salinity, and multi-component liquids. The principle of the method is to establish the relationship among the concentration of the target substance in the liquid (*C*), the color space coordinates of the target substance at different concentrations (*L**, *a**, *b**), and the maximum absorption wavelength (λ_{max}); subsequently, the optimum wavelength λ_T of the liquid is determined by a high-precision scanning-type monitoring system that is used to detect the instantaneous concentration of the target substance in the flowing liquid. Unlike traditional monitoring methods and existing online monitoring methods, the proposed method does not require any pretreatment of the samples (i.e., filtration, dilution, oxidation/reduction, addition of chromogenic agent, constant volume, etc.), and it is capable of original-state online real-time monitoring. This method is employed at a large electrolytic manganese plant to monitor the Fe^{3+} concentration in the colloidal process of the plant's aging liquid (where the concentrations of Fe^{3+}, Mn^{2+}, and $(NH_4)_2SO_4$ are 0.5–18 mg·L^{-1}, 35–39 g·L^{-1}, and 90–110 g·L^{-1}, respectively). The relative error of this monitoring method compared with an off-line laboratory monitoring is less than 2%.

1. Introduction

Large amounts of complex liquids with high viscosity, high salinity, and multiple components are used in the production of nonferrous metals, petrochemicals, coal coking, and other industries. Online real-time monitoring of the concentration of the target substances is of great significance for the real-time adjustment of the working conditions and for pollution reduction. For example, in the wet process of the nonferrous metallurgical industry, it is necessary to strictly control the target metal ions and impurities during the purification and aging of new electrolytes and during electrolyte mixing in order to ensure the quality of the electrolytes. However, because the high salinity, strong coating, multi-ion states, and multi-phase coexistence interfere with the electrolyte system, it is impossible to carry out online real-time monitoring with current technologies.

Given this problem, researchers worldwide have conducted preliminary investigations into the online real-time monitoring of complex liquids [1,2]. In the field of online monitoring for organic matter, Motteran et al. [3] developed an online liquid analysis chromatography–tandem mass spectrometry (LC-MS/MS) technique that was able to detect different anionic and nonionic surfactants in laundry wastewater and anaerobic fluidized-bed reactor effluent. Salazar-Beltrán et al. [4] achieved the automatic detection of three kinds of phthalates by coupling an online solid-phase extraction (SPE) technology with liquid chromatography–ultraviolet spectrophotometry (LC-UV) and using a flow injection technique. In the field of online monitoring for inorganic ions, Lv et al. [5] developed an electrochemical monitoring instrument capable of the fully automatic monitoring of heavy metal ions in water. Dadfarnia and Jafarzadeh [6] and Anthemidis et al. [7]