Modelling of an ozonation process for cyanide removal from blast furnace gas-washing water and analyses of process behaviour in different scenarios

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Abstract

Process industry develops research activities for improving wastewater quality. In the steel sector, a topic is the control of cyanide in the wastewater of the gas washing (GW) system of blast furnaces (BF). Nowadays, the cyanide content of such water is reduced by means of well-established treatments such as Degussa method. However, costs, chemicals toxicity, varying separation efficiencies because of changing BF operational conditions and increasing environmental requirements could lead to the need of modifications of current treatments or the development of new methods. A cyanide treatment based on ozonation is one of the proposed methods during the European project entitled “DynCyanide”. The ozonation is an efficient process to remove cyanide from municipal and industrial wastewater [1-2]. However, ozonation is affected by several factors related to the features of the water to be treated [3-5]. Only recent studies exists related to the cyanide removal through ozone from BF gas washing wastewater [6] that is characterized by a wide range of varying contaminants that can compete to the ozone consumption. For this reason, experiments were performed through a pilot plant to improve understanding the ozonation process, the competing reactions and the cyanide removal efficiency. Furthermore, a process model was developed in order to extend the experimental studies in a wide range of operating conditions and wastewater features that can vary from plant to plant. The paper focuses on the process modelling and simulation phases that were carried out using the software Aspen Plus®. A literature analyses and a collaboration with process developer were fundamental to obtain know-how and data. Water stream and ozonation were modelled with several theoretical reactors considering main and collateral reactions. In order to reproduce the kinetic of these reactions, a genetic algorithm was applied, which exploits the analysed data to find the best fitting kinetic law to be inserted in the Aspen model. Electrical conductivity FORTRAN-based calculator and Excel-based blocks were developed to give punctual main chemical compounds content at each treatment minute.
The validated model was used to make scenario analyses, process knowledge was enhanced, and suggestions were obtained about the behaviour of the ozonation process in different conditions that are useful to verify the robustness of the process in this highly variable application and to improve its performances.