Toxicity and Degradation of the Wastewater of the Urea Fertilizer Plants, Oxidation of Fenton and *Pseudomonas fluorescens* Bacteria

M. Hatta Dahlan, M. Faizal, Arinafril, Marsi, Marhaini

ABSTRACT __Treating the wastewater with high level of urea and ammonia-nitrogen is one of the problems faced by urea fertilizer plants in Indonesia. The alternative treatment being studied is the one which uses Fenton oxidation process which is continued with the use of *Pseudomonas fluorescens* bacteria. This study is conducted with the concentration of ammonia-nitrogen of 2500 ppm, 2000 ppm, and 1500 ppm. The response being observed is the level of ammonia-nitrogen (NH_3-N) and nitrate-and nitrite in the influent and the level of ammonia-nitrogen (NH_3-N) and nitrate-nitrite in the effluent. This study also aims to estimate the IC_{50} (Inhibition Concentration), NOEC (No Observed Effect Concentration) and LOEC (Lowest Observed Effect Concentration) for 96 hours after being given toxicant in the form of the wastewater of the urea fertilizer plants against the development of the number of cells of *P. fluorescens.* The value of IC_{50} after 96 hours of being given the toxicant of the wastewater of urea fertilizer plants against *P.fluorescens* is 723,219 ppm, while the value of LOEC is 393, 992 ppm and that of NOEC is 2533,658 ppm. The result of the study shows that the biggest average percentage of decline of ammonium is that of the level of ammonium-nitrogen of 2500 ppm in a ratio of 1:10 which is 94.50%. Further study using *P. fluorescens* results in a decrease of nitrate-nitrite in the ratio of 1 : 4 and 1 : 6 which satisfies the quality standards specified in the Environment Minister's Decision No.122 of the year 2004 and the Decree of the Governor of South Sumatra No. 18 of the year 2005. The result of this study provides a fairly high efficiency, hence it is expected that it can be applied in the industrial world.

Keywords: *Ammonia-nitrogen, Fenton oxidation, P.fluorescens, Toxicity*

M. Hatta Dahlan, Chemical Engineering, Faculty of Engineering Sriwijaya University Indonesia, e-mail halogeneted@hotmail.com

M. Faizal, Chemical Engineering, Faculty of Engineering, Sriwijaya University, Indonesia, e-mail

Arinafril, Department of Pests and Diseases, Faculty of Agriculture, Sriwijaya University, Indonesia, e-mail arinafril@fp.unsri.ac.id

Marsi, Department of Soil Science, Faculty of Agriculture, Sriwijaya University, Indonesia, e-mail mbasihin1960@yahoo.com

Marhaini, Chemical Engineering, Faculty of Engineering, Muhammmadiyah University, Palembang, Indonesia, e-mail marhainiump@yahoo.co.id

I. INTRODUCTION

In Indonesia, there are six urea fertilizer plants with wastewater characteristics of high levels of ammonia-nitrogen and urea. Up to the time of this study, the process of sewage treatment of those plants is by containing the wastewater in large pools with no special treatment or setting of operating conditions, therefore the output process does not always satisfy the quality standards specified in the Environment Minister's Decision No.122 of the year 2004 and the Decree of the Governor of South Sumatra No. 18 of the year 2005. Ammonia compound has been widely known as an important raw material for some important commodities in the industrial world. On the other hand, ammonia is also one of harmful pollutants. Ammonia compound in the water at a certain concentration can disrupt ecosystems because it causes eutrophication of aquatic ecosystems, inhibits the metabolism of aquatic animals, and it can even lead to poisoning resulting in organ damage and death. In principle, the nitrogen compounds in the wastewater which can cause pollution are: ion of ammonia (NH_3), nitrite ions (NO_2-) and nitrate ions (NO_3-) [22] Biological waste treatment processes (microbes) will not run optimally or will be impaired when the waste contains toxic chemicals that will affect the performance of a waste treatment facility[15] . This advanced oxidation process can be used as an alternative method of treating industrial wastewater of the urea fertilizer plants which is quite economical. The use of this process can save space and energy, and it is safe and simple, and processing and reaction time is relatively fast and it is easily applied and controlled.

Some strong oxidizing agents such as peroxide is relatively inexpensive and easy to obtain and can be used as an oxidizer in advanced oxidation processes. Hydrogen peroxide (H_2O_2) has long been known as a strong oxidizing agent and is able to oxidize organic and non-organic compounds and is widely used in various industries. Hydrogen peroxide is an oxidizing agent which is safe enough in terms of its end product in which after the process it will be split into H_2 and O_2 at the temperatures above 80^{o}C. Fenton reagent is a peroxide compound which is reacted with catalyst Fe^{2+} ($FeSO_4$) which will produce hydroxyl radicals (^OOH) which are effective compounds to oxidize contaminants or waste water. Fenton reagents have been developed in many places to process organic materials of *Biological Oxygen Demand / Chemical Oxygen Demand*