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HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW*
KARYA ILMIAH : JURNAL ILMIAH

Judul Karya Ilmiah (artikel : Kinetics and morphology analysis of struvite precipitated from aqueous solution under the influence of heavy metals: Cu^{2+}, Pb^{2+}, Zn^{2+}

Nama Penulis : D.S. Perwitasari, S. Muryanto, J. Jamari, A.P. Bayuseno

Jumlah Penulis : 4

Status Pengusul : Penulis keempat/penulis ke-4/Penulis korespondensi*

Identitas Jurnal Ilmiah :
- a. Nama Jurnal : Journal of Environmental Chemical Engineering
- b. Nomor ISSN : 22133437
- c. Volume, Nomor, Bulan Tahun : 6, Issue 1, February 2018, Pages 37-43
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- e. DOI artikel (jika ada) : /10.1016/j.jece.2017.11.052
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- g. Terindeks di Scimagojr/Thomson Reuter ISI Knowlegde, ESCI, Gale, SCOPUS,EBSCO Host

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Lingkup pembahasan artikel ini adalah pada kinetika kecepatan pengendapan struvite, beserta karakteristik morfologi produk yang dihasilkan. Kecepatan pengendapan sangat penting terkait dengan desain perancangan dimensi unit pengolahan limbah yang tepat. Pembahasan dilakukan secara sistimatis dan komprehensif, serta sangat jelas dan dalam. **(nilai: 11,5).**

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Kinetics and morphology analysis of struvite precipitated from aqueous solution under the influence of heavy metals: Cu^{2+}, Pb^{2+}, Zn^{2+}

Perwitasari D.S.[a], Muryanto S.[b], Jamari J.[c], Bayuseno A.P.[c]

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Kinetics and morphology analysis of struvite precipitated from aqueous solution under the influence of heavy metals: Cu^{2+}, Pb^{2+}, Zn^{2+}

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ARTICLE INFO

Keywords:
Struvite
Heavy metals
Kinetics
XRPD Rietveld
Morphology

ABSTRACT

The present study examined the influence of metal ions (Cu^{2+}, Pb^{2+}, and Zn^{2+}) on kinetics and morphology of struvite precipitated from aqueous solutions containing equimolar ratios of struvite components: Mg^{2+}, NH_4^+, PO_4^{-3}. Kinetics of the struvite precipitation in the presence of metal ions [0,1, 10, 50 and 100 ppm] was evaluated through the change of pH of the precipitating solution. The kinetic evaluation demonstrated that the precipitation satisfactorily followed the first-order kinetic with respect to Mg^{2+}. It was found that for the three metal ions tested, the higher the concentrations of the metal ions: 0, 1, 10, 50, 100 ppm, the less the crystals obtained and the lower the rate constants. Depending on the concentrations of the metal ions added into the solution, the rate constants varied from 4.344 to 1.056 h^{-1} which agree with most published values. It was postulated that the metal ions were adsorbed onto the surface of the crystals and hence retarded the growth. The crystals obtained were characterized using SEM-EDX and XRPD Rietveld. The characterization revealed that the precipitates were mainly struvite of various sizes (between 10 and 60 μm) with sylvite as impurities. It is envisaged that the present study would add to the understanding of the removal of metal ions from industrial wastewater through struvite precipitation.

1. Introduction

Wastewater contains a particularly high concentration of phosphate, potassium, and ammonia which may cause eutrophication of surface waters [1]. The phosphorus concentrations in the wastewater can be reduced through mass crystallization of sparing struvite [$MgNH_4PO_4 \cdot 6H_2O$] on a mechanical mixing equipment [2,3]. In addition, the wastewater containing heavy metals namely, copper (Cu^{2+}), lead (Pb^{2+}) and zinc (Zn^{2+}), could have a negative effect on health, environment, equipment, and the aesthetic quality of the water bodies. Correspondingly, traces of heavy metals contaminated wastewater must be treated prior to its release to the environment [4,5].

Toxic heavy metals from inorganic effluent can be stabilized through conventional methods such as precipitation, cementation, sedimentation, filtration, coagulation, flotation, ion exchange and, adsorption [6–8]. However, these methods often lead to incomplete treatment, high-energy consumptions, and still produce an output of toxic sludge or waste products [9]. In this way, the conventional precipitation of heavy metals to yield hydroxides have shown the ineffectiveness in metal immobilization, especially when their concentrations are low in the solution. Alternatively, heavy metals in the wastewater can be removed simultaneously from the wastewater with a recovery of potassium, phosphate and ammonia using the precipitation agents [e.g., KOH and Mg $(OH)_2$], to produce struvite and/or struvite-K [$KMgPO_4 \cdot 6H_2O$-(KMP)] [10]. Currently, the recovery of six heavy metals [Cu, Ni, Pb, Zn, Mn, Cr (III)] from solutions can be enhanced by utilizing the self-synthesized struvite under pH variations of 6.0–10.0. Results indicated that more than 95% of those six heavy metals could be taken out from the solution by struvite precipitation [11], and the precipitating solid contains the highest quality of struvite (97%) which could be potentially utilized as fertilizer [12].

Correspondingly, several kinds of reactor systems have been developed to facilitate the wastewater treatment for not only sustainable recovery of phosphorus but also the adsorption of metals and organics into the surface of crystal struvite [5]. Consequently, the heterogeneous nucleation mechanism and crystal growth of struvite may be influenced by the presence of heavy metals. The exchange between ionized metals such as cadmium, zinc, and nickel with magnesium can occur in the crystal lattice of struvite [3]. Therefore, the interaction between metals and struvite during co-precipitation and adsorption have become a

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Antibiotic resistance and wastewater: Correlation, impact and critical human health challenges

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ARTICLE INFO

Keywords:
Antibiotic over-use
Antibiotic resistance bacteria
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Health hazardous

ABSTRACT

The spread of bacterial antibiotic resistance (due to over and non-judicious use of antibiotics) is an apprehensive subjects matter and the role of wastewater treatment plants has been attracting particular interest. These stations are a reservoir of resistant bacteria, and the amount of bacteria released into the environment is very high and dangerous. The reuse of treated wastewater for irrigation is a practical solution for surmounting scarcity of water, but there are several health-related and environmental risks associated with this practice. It may increase antibiotic resistance (AR) levels in soil and water. Wastewater treatment plant effluents have been recognised as significant environmental AR reservoirs due to selective pressure generated by antibiotics that are frequently discharged in water. It also enhanced the possibility of horizontal gene transfer by increasing the abundance of the resistance gene. This review focuses on the emergence of antibiotic resistance in waste water, waste water treatment, challenges and their impact on human health. Based on the current state of the art, we conclude that the improvements in wastewater treatment technologies are required that not only remove solids, organic matter, and nutrients but also they could remove AR element and bacteria.

1. Introduction

The whole world is facing an ever increasing shortage of water and in most part of the word; the reuse of treated or untreated wastewater is the main source of water for agriculture as freshwater availability is not sufficient. Nevertheless, numerous environmental and health risks are associated with reuse of wastewater. Therefore, pollution measures are necessary to avoid biological risks and ensure the safe use of wastewater. In the recent past, personal care, pharmaceuticals, and human health related products containing antibiotics have been identified as emerging contaminants and threat of aquatic environment. Presence of antibiotics in our environment has been reported throughout the globe in groundwater, sediments, surface water [1–3]. Water bodies are getting contaminated with antibiotic due to their unsafe disposal and its concentration is increasing day by day due to increase in the population, urbanization, industrialization, and wrong agricultural practices.

Therefore, treatment of wastewater is carried out for the purpose of reducing the pollutants by removing pathogens, biodegradable substances, nutrients to ensure public health and protecting the environment. Furthermore, with the increase in water demand, the recycling of wastewater has been brought into question and efficient functioning of sewage treatment is needed. Many surveys revealed the presence of antibiotics in wastewater treatment plants. Surveys were carried out by taking frequent samples, including influent, the supernatant of the primary sedimentation tank, the mixed liquid in the aeration tank, effluent after disinfection, rejected water from sludge dewatering, supernatant in the secondary sedimentation tank, etc. Increasing concentration of multiple antibiotics led to the proliferation of resistant bacteria in the environment. High concentrations of multidrug-resistant bacteria have also been detected in hospital wastewater, domestic sewage, and drainage from livestock feeding process which is a severe threat to the human health [4–6]. Recently, the impact of antibiotic residues on ecosystem has been recognised as an international threat [7]. Aquatic and terrestrial organisms have been affected by the extensive presence of antibiotics in the environment [8], besides, alteration in microbial activity and community composition [9], and prevalence of bacterial resistance to antibiotics [10]. Moreover, antibiotics produced from anthropogenic sources may lead to entering into the environment via wastewater treatment plants if the removal is not complete, or wastewaters are untreated [11]. The excretion of incompletely metabolized antibiotics by humans and animals is the primary source of antibiotics in the environment. Other sources may include the disposal of unused antibiotics and waste from pharmaceutical manufacturing processes. Residential (private residences, dormitories,

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Threats from antibiotics: A serious environmental concern

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ARTICLE INFO

Keywords:
Antibiotics
ARB
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Ecosystems
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Environment

ABSTRACT

Antibiotics are bioactive substances, used as human and animal medicines for illness prevention, disease treatment and growth promotion. They are considered to be pseudo persistent given their continuous input in the environment. Antibiotics enter agro ecosystems through several routes such as wastewater irrigation, soil application, animal manures or bio-solids which are mostly biologically active thus creating potential risks to the environment. They are present in different environmental matrices at low concentrations as residues. Antibiotic residues enter the environment primarily via urine, feces and manure from humans and animals after they have taken the medication, as well as from manufacturing wastewater. These residues contaminate the soil, surface water, and groundwater by leaching or runoff and ultimately breed antibiotic-resistant bacteria (ARB) and genes (ARG). These triune threat viz antibiotics, ARB and ARG have not been effectively removed by various treatment in wastewater treatment plants. Here, we put together existing knowledge and aim at providing in-depth knowledge to the extent to which a wide range of treatment processes determine the ultimate fate of antibiotic-bred threats (ARB and ARG) in conventional and advanced wastewater treatment. The use of antibiotics is inevitable, hence studies focusing on minimizing their discharge into the environment viz-a-viz support future regulatory measures are of great importance.

1. Introduction

Antibiotics have gained significant attention due to their widespread use in diseases treatment caused by both pathogenic and non-pathogenic bacteria. Their role in the contamination of surface water, groundwater, and environmental soil is on the increase. The pollution caused by excessive use of antibiotics is a potential threat to human health as it promotes antibiotic-resistant bacteria (ARB) breeding. ARB and antibiotic resistance genes (ARGs) have been detected in different media, such as drinking water [1], surface water [2] and soil [3]. As a result of their threat to public health, the World Health Organization (WHO) has categorized their spread as one of three most serious threats to public health in the 21 st century [4]. Extensive use of antibiotics has led to the emergence of both ARB and ARG, which poses serious threat to human health [5]. In wastewater treatment plants (WWTPs), antibiotics are only moderately removed [6] thus ARG proliferation may occur and eventually spread in the environment [7,8,9]. In order to trim down the risk of ARB&ARGs emission to the environment, it is essential to study their outcome and abundance during the improved elimination of antibiotics. This review aims at considering the various studies on the occurrence as well as removal of antibiotic-resistant bacteria and genes from wastewater effluents and environmental samples, the various challenges and future prospects militating against their resistances are also discussed.

2. Antibiotic-resistant bacteria: a silent threat in the environment

Effective wastewater treatment has been well advertised with serious focus on industries and municipal wastewater, only little attention has been given to treatment of hospital and other health care facility wastewater. Wastewater from health care facility may be a source of serious antibiotic pollution as well as platform for the growth of resistant bacteria [10]. Although antibiotics can be released into the water bodies via other sources such as the urban wastewater treatment plants, runoff from agricultural activities, indiscriminate disposal of expired and unused prescriptions as well as effluents from pharmaceutical industries. Whatever the source of antibiotic in water, the concern remains the generation of antibiotic-resistant gene (ARG) and

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