Potential Research Bioremediation of POPs (Persistent Organic Pollutant) in Indonesia

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ABSTRACT

The Stockholm Convention aims to protect human health and environment from Persistent organic pollutants (POPs). As a country has ratified the Stockholm Convention, Indonesia has obligation to conduct activities with the final goal of reducing and the phase out of POPs. POPs are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, bioaccumulate in food chains, and to have potential significant impacts on human health and the environment. Persistent Organic Pollutants (POPs) become one of the major problems for the environment in the last years. Their properties that can resist in the atmosphere for several years and easy moving over the long area, make this problem become more serious. Identification of Contaminated site and remediation in an environmentally sound manner, but recently remediation has not been perfomed. In Indonesia, Research bioremediation of organic pollutants have been carried out by researchers at universities and research institutes both LIPI, Pusarpedal, BPPT and other research institutions. Bioremediation Indonesian Forum has been established and its action immediately realized in field applications.

Key words : *Persistent organic pollutants (POPs), Bioremediation*

INTRODUCTION

The effect of POPs on human and environmental health was discussed, with intention to eliminate or severely restrict their production, by the international community at the Stockholm Convention on Persistent Organic Pollutants in 2001.

Many POPs are currently or were the past as pesticides, B3 (hazardous material), Drug, Health supplement and Food material, determination of the maximum limit of microbial and chemical contaminant (dioxin) in food (meat, fish, butter, milk), cosmetics. Fungicides, insecticides, hydrocarbon, PCB in electrical equipment, DDT residue. Others are used in industrial processes and in the production of a range of goods such as solvents, polyvinyl chloride, and pharmaceuticals. There are a few natural sources of POPs, such as volcanic activity and vegetational fires, but most POPs are created by humans in industrial processes, either intentionally or as by products.

Public concern about contamination by POPs exists, due to the multitude of evidence showing the negative effects of POPs on human health and the environment. Several compounds have been identified as hormone disruptors which can alter normal function of endocrine and reproductive systems in humans and wildlife. Cardiovascular disease, cancer, obesity, and diabetes have also been linked to POPs. Exposure to POPs during pregnancy has been linked to developmental defects in the resulting offspring. There are many risks and effects of having these chemicals in our environment and none of them are a benefit to the Earth. After these pollutants are put into the environment, they are able to stay in the system for decades causing problems such as cancer, birth defects, learning disabilities, immunological, behavioral, neurological and reproductive disorders in humans and animals.

All the countries such as America, Japan and Europe have long been aware of the dangers of POPs on human health and the environment. Concern was marked by the implementation of the agreement on POPs in the Stockholm Convention in May 2001, which Indonesia also took part in the convention. The Convention aims to protect human health and the environment from persistent organic pollution (Noor et al, 2008).

Persistent Organic Pollutants (POPs) are organic compounds that can last a relatively long time in the environment because of the difficulty of these compounds are degraded through chemical processes, biological, and photolysis. These compounds are poorly soluble in water but soluble in fat tend. Because of this nature, POPs tend to be accumulative and is always found in the environment. In addition, these compounds also are semi-volatiles that may be present in the vapor phase or adsorbed on the dust particles, so that POPs can travel long distances in the air before being deposited on the earth (Nahas, 2008)

In 2001, the United Nations Environment Pragramme (UNEP) through a convention which was held in Stockholm, Sweden, gave birth to an agreement on the control of POPs emissions that are harmful to living things and the environment. Initially there were 12 chemicals classified as POPs by its nature resistant in the environment, bioaccumulate in living organisms, and has a high toxicity. Of the 12 compounds, nine of which are contained in the pesticide compounds, namely Aldrin, chlordane, DDT, dieldrin, Endrin, heptachlor, hexachlorobenzene, Mirex, and toxaphene. the compound is the result of the chemical industry, namely polychlorinated biphenyls (PCBs), while the two compounds, namely polychlorinated on benzo-p-dioxins and Dibenzofurans polychlorinated is a byproduct of the chemical industry (Nahas, 2008).

Monitoring on POPs and PFOS by PUSARPEDAL of Environment Ministry

Monitoring on environment as the impact of organ chlorine pesticides, Persistent Organic Pollutants (POPs) and Polychlorinated Bhiphenyls (PCBs) had been on April to October on 2007. Sampling points take from seven cities for OCs and Pos, One City for PCBs in Indonesia. The location are agriculture, river and

farm area in Medan (North Sumatera), Lampung, Cianjur, Karawang, Brebes (central Java), Dieng (Central Java) and Batu (East Java). For PCBs the sample was taken from Workshop for collect the old transformer and workshop for collected and reuse the waste oli in Semarang. The sample are water, soil and sediment.
The POPs as the target are Aldrin, Heptaklor epoksid, cis-Klordan, trans-Klordan, p,p'-DDE, Dieldrin, Endrin, p,p'-DDD, o,p'-DDT, p,p'-DDT and Polychlorinated Bhiphenyls (PCBs) . Even thought, organ chlorine pesticides as α-HCH, β-HCH, BHC,γ-HCH, δ-HCH, Heptaklor and Metoksiklor were determination also. The purpose from this monitoring to identify of Pops and organochlorine pesticides in water, soil and sediment. The target compounds were extracted by organic solvent and clean-up, analysis by GCMS QP 2010.

The result from analysis data show that POPs Still detect. It had DDT and the derivate such as pp-DDT, op-DDT ,DDD and DDE. The level concentration for that compound about 0.037 ng/ml (ppb) to 35.5 ng/ml (ppb) for water sample,and the highest level in soil and river sediment in level 97.1 ng/g (ppb)..

U.S. Patent Bioremediation of POPs

Actually research of Bioremediation of persistent organic pollutants using microorganism have been done and have Patent application number: 20140042087 by Inventors: Kevin O'Driscoll (Princeton, NJ, US) Raymond Sambrotto Title research is Bioremediation of persistent organic pollutant using thermophilic bacteria. The present application relates to a method of degrading organic contaminants in contaminated soil, sediment or wastewater, the method being carried out by treating the contaminated soil, sediment or wastewater with thermophilic bacterium capable of degrading the organic contaminants.

POTENTIAL RESEARCH

In Indonesia, the potential for bioremediation studies have been carried out by a lecturer /researchers in collaboration with undergraduate and postgraduate students in different universities, although in a laboratory scale. Microbiology Laboratory of the Research Indonesian Institute of Sciences (LIPI), Pusarpedal, BPPT and other research institutions. In cooperation with the Ministry of Environment and the Ministry who is concerned to minimize degrade POPs and PFOS with both in situ and ex situ is a shared responsibility in the framework program pollution management.

The presence of POPs in nature, whether contained in the land, waters, and atmosphere, has become the attention of researchers. it is associated with POPs properties that can survive long in the environment and also a high level of toxicity, so that the presence of POPs into a thorny problem, both for the environment and living things. Research conducted Simonich and Hites (1995) on more than 200 samples collected bark from 90 locations around the world indicate that relatively

high concentrations of POPs in almost all types of sampling locations, both in industrialized countries and in developing countries. In fact, although some compounds such as DDT and ɣ-HCH has been banned in many countries, but the measured concentration is still quite significant. meanwhile, POPs threat to living beings is the nature bioaccumulation in fatty tissues so that the concentration of these compounds can be increased through the process of the food chain. Our results of Lee et al. (2006) showed a close relationship between high concentrations of POPs in people with diabetes.

In addition to its toxicity, POPs also be a danger to the environment because of its ability to travel long distances. this is because POPs are semi-volatile so easily carried by the flow of air masses. Coupled with resistance in the environment so that POPs can be detected in almost all the places on earth. Fate and Transport Ocean Model (FANTOM) demonstrates that there are four ways POPs can place, namely (Nahas, 2008):

1 Transfer through ocean currents. In the sea water, POPs are transported by turbulent diffusion and advection processes.
2. Air-sea exchange can occur through three mechanisms: reversible gas exchange, dry particle deposition, and wet deposition.
3. Distribution phase. POPs either dissolved or incorporated in the particles of water, ocean currents will follow. Gravity and gravity will make these compounds in the bottom sediments terndap. Spread back POPs may occur due to disturbance of sediment layers by biological activation or erosion processes.
4. Degradation of sea level.

Of the few studies on the impact of chemical residues and POPs for living things found indications of danger that can threaten human health and the environment. Threat to humans, among others, the disruption of the reproductive system (infertility), decreased immunity in infants and children, physical and mental abnormalities, lead to cancer, interference with the function of organs such as the liver, lungs, kidneys, thyroid, hormone system endocrine, and reproductive organs. POPs contamination in ingkungan cause the extinction of certain species, decline in bird populations and so on.

2 PFOS

PFOS (perfluorooctane Sulfonate) is an organic pollutants scattered everywhere. PFOS largely ignored over the years due to the fact that substances that accumulate in tissue proteins than lipids like most POPs. Nevertheless, PFOS is still accumulating in the Arctic area. a study on the presence of PFOS in the liver of animals Artic mengunkapkan PFOS levels increased in almost all species studied (Alexander et al, 2008).

According to researchers at the European, PFOS has contaminating fresh water, so the water has been contaminated. PFOS was also seen in fish and fishery products. has been analyzed in a limited number of European environmental samples and food (especially fish). PFOS concentration is almost always higher than the concentrations of PFOA and PFOS concentrations in fish liver were consistently higher than the fillet. PFOS has been shown to bioaccumulate in fish and kinetic bioconcentration factor has been estimated to be in the range of 1000 -. 4000 Time to reach 50% clearance in fish has been estimated to be about 100 days (Alexander *et al,* 2008).

CONCLUSION

1. Research collaboration bioremediation of persistent organic pollutants is needed both in the laboratory and field scale on both Universities laboratory and research institutions and other relevant departments.
2. 2 Establishing a system for identification and Monitoring regularly about the use of POPs and PFOS in a sustainable manner.

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