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TYPES OF ORGANISMS DECOMPOSERS OF SOIL POLLUTANTS

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A B S T R A C T

Pollutants will land declining soil quality and land productivity and lower the carrying capacity of land to humans and the environment. Various types of pollutants require certain types of soil organisms to decompose both microbes and soil fauna, so this paper focuses on identifying the types of decomposers in each pollutant. Soil microbes (bacteria) are more widely used for various types of pollutants while the soil fauna acts as a chunk of solid material which will then be broken down by microbes.

1. Preliminary

Soil contamination is a condition of the entry of one or many chemical, physical, or biological objects into the soil where they can damage the soil structure and make the plant difficult to adapt. P pollution or pollution can be distinguished into pollution of soil, water, air, or from sound. P soil contamination is mostly caused by organic and inorganic waste coming from household waste, market, industry, agriculture activities, livestock and others there is easy to describe there is also garbage which is very difficult to decipher even take years.

In the living soil various organisms (microorganisms and fauna) that perform various activities for the life of other living beings or with other words make the land possible for the continuation of natural beings . The microbiological population that inhabits the soil, along with various forms of animals and other higher-level plants forms a system of life that is not separate from mineral materials and the remaining organic material present in the soil. The quantitative composition of the population in the soil and the qualitative nature of the environment can be characterized as highly dependent on the source and natural conditions of the soil and the relative composition of the organic and inorganic elements. Decomposers are living things that serve to describe living things that have died or decompose waste materials so that the material described can be absorbed by plants that live around the area. But any waste or waste that exists in the environment have different structures and contents that will affect the organism that is able to decipher the material. Therefore this paper would like to answer what types of decomposers (decomposers) that can reduce the contaminants on the soil. Objectives to be achieved is to analyze the type of organisms both microbes and soil fauna for pennguraian contaminants soil.

2. Soil Pollutants

Waste is waste / waste generated from a production process both industrial and domestic (household). While in the Act No. 18 of 2008 on Waste Management, it is mentioned that waste is the residual activity of human daily or natural process in the form of solid or semi-solid in the form of organic or inorganic substances are biodegradable or not biodegradable which is considered to be useless and discarded environment. Soil contamination occurs when waste is not disposed of properly or can occur when humans dispose of chemicals to the soil in the form of domestic, market and domestic waste, pesticides, insecticides and fertilizers in agricultural practices. Mineral exploitation (mining activities) has also contributed to the destruction of the land.

Plastic wastes are made from synthetic materials, generally using petroleum as the base material, plus additional materials which are generally heavy metals (cadnium, lead, nickel) or other toxic materials such as Chlor. This plastic toxin is released when it breaks down or burns. Decomposition of the plastic will release various types of heavy metals and other chemicals it contains. These chemicals dissolve in water or are bonded to the ground, and then enter our bodies through food and drink. While plastic combustion produces one of the most dangerous materials in the world, namely Dioxin. Dioxin is one of the few chemicals that have been studied intensively and has been confirmed to cause cancer. The danger of dioxin is often paralleled with DDT, which has now been banned all over the world. In addition to dioxin, combustion ash also contains various heavy metals contained in the plastic.

According to Darmono (1995), the factors that cause metal weight including in group substance contaminants is because existence properties metal weight that is not could decompose (non degradable) and easy absorbed . Organism The first affected effect addition pollutant metal weight to soil or other habitats is organism and plants that grow in soil or the habitat. In ecosystem natural there interaction between organism good interaction positive as well negatives that describe form of energy transfer between population in community the . With thereby influence metal weight the on finally will to on hierarchy chain food the highest that is human . Metals weight is known could gather in in body something organism and permanent stay in body for period long time as toxins that accumulate (Saeni, 1997).

Soil contamination usually occurs due to: leakage of wastewater or industrial chemicals or commercial facilities; use of pesticides; the entry of contaminated surface water into the sub-surface layer; accidents of vehicles transporting oil, chemicals or waste; waste water from waste dumps and industrial waste directly disposed of in *illegally dumped* land . When a hazardous substance has polluted the soil surface, it can evaporate, be swept away by rainwater and or enter the soil. Pollution into the soil then settled as a toxic chemical on the ground. Toxic substances in the soil can have a direct impact on humans when in contact or can contaminate groundwater and air above it (Veegha, 2008) **.**

Waste is discharged from a production process both industrial and domestic (household, better known as waste), whose presence at a certain time and place is not desired by the environment because it has no economic value. When viewed chemically, this waste consists of organic and inorganic chemicals. With certain concentrations and quantities, the presence of waste can have a negative impact on the environment, especially for human health, so it needs to be handled to waste. The level of danger of toxicity caused by the waste depends on the type and characteristics of the waste (Wikipedia, 2009).

3. Decomposition of Soil Pollutants

3.1. Decomposition of plastic materials

Plastic is a waste that is mentioned can not decompose, is not environmentally friendly, and is the most dangerous and troublesome waste that is the main problem of handling the world's waste. Although it can decompose, the plastic takes up to thousands of years to break down.

Japanese scientists studied the decomposition process of PET plastic (Poly ethylene tetra) , and found the bacteria *Ideonella sakaiensis* which uses two kinds of enzymes to crush the plastic into eco-friendly substances. Then the resultant substance destruction of PET plastic is used as a food source for the bacteria colony *Ideonella sakaiensis* . The bacteria use a carbon-containing decomposition agent for their growth. The bacterium takes 6 weeks to decompose low quality PET plastic. The optimum condition of this bacterium to decompose PET plastic is at a temperature of 30 ^{0} C. Both of these enzymes are ISF6_4831 and ISF6_0224. They are professionally assigned, where the ISF6_4831 enzyme is assigned to decompose PET into simpler chemical elements, while the other, the ISF6_0224 enzyme is tasked with completing and refining the process. When the decomposition process is complete, the plastic can later be converted to carbon dioxide and water. These bacteria are able to consume PET (small size) in just six weeks if stored at a temperature of 86 degrees Fahrenheit, and the future will be developed so that these bacteria can consume in a larger mass.

Mealworm or also called hongkong caterpillar / caterpillar flour which is usually used as food birds who step in it can mengura plastic garbage fish Styrofoam (type of plastic from polystyrene material). Based on 2 studies from ch ina one of them Weimin Wu Environmental Engineering expert, Microbiology proves hongkong worms can eat plastic garbage Styrofoam . By providing 34-39 milligrams of styrofoam to hongkong worms, Styrofoam transformed into CO2 less than 24 hours is a very fast process. Tests In both studies Weimin Wu uses microbials in the digestive tract of hongkong caterpillars, where the microbes are able to decipher styrofoam even though the process is slow. Weimin Wu's research opens opportunities to solve plastic waste problems especially styrofoam, in the future Weimin Wu tries to look for hongkong caterpillar-like organisms in the sea, thus solving the waste problem at sea.

Adam Gusse and colleagues from the University of Wisconsin-La Crosse then examined the benefits of fungi that usually live at the base of the rotting stem. This white fungus produces an enzyme that can break down the hard lignin layer. Lignin has a chemical structure similar to phenol resins because it is composed of bonded molecules. Gusse puts phenol resin flakes into five different mushroom species to compare his influence. The research team saw there was a species called *Phanerochaete chrysosporium* which changed its body color from white to pink after a few days. This suggests that the fungus has decomposed resins into smaller pink polymer molecules. They make sure the findings after feeding the mold with phenolic resin containing the heavier carbon isotopes h isilnya, isotopes are absorbed into the body of the fungus.

3.2. Decomposition of organic matter

In the process of decomposition of organic materials of cellulolytic microbes secrete cellulose enzymes that play a role in accelerating the process of hydrolysis of cellulose and other polysaccharides. Decomposition of these materials will overhaul the physical properties of matter, and will release some nutrients, such as Nitrogen, Phosphat, Potassium, and Sulfur. Nutrient elements resulting from this decomposition process will be utilized by microorganisms to support their metabolism. Thus, the activity of microorganisms will increase, so that the process of decomposition and reshuffling of organic materials will progress more quickly. This decomposition process will produce carbon, which is partially released in the form of simple sugars, while the remaining carbon is released into the air in the form of CO2. Thus, the content of C (carbon) in the organic material becomes reduced, and the condition will automatically decrease the C / N ratio.

In the reshuffling of organic materials, unbranded cellulose, such as aquatic plant tissue without woody, paper or cotton paper waste will be more quickly decomposer decomposer decomposes, compared with lignin plants, especially woody plants. This is due to woody plants, cellulose and ligni n will form lignose-lulose that is resistant to microbial activity. Therefore, for composting the ingredients of woody plant tissue, the role of lignin-producing microbial enzymes, such as *Paecilomyces sp* ., *Allezcheria sp* ., *Chaetomium sp* ., *Poria sp* ., *Nocardia sp* ., *Streptomyces sp* ., *Pseudomonas sp* ., and *Flarocacterium sp* .

Some types of earthworms include: *Pheretima, Periony and Lumbricus.* These three types of earthworms like organic materials derived from manure and plant debris. Worms have many uses, among others: helping to destroy organic matter that can affect the fertility of a soil, Animal Feed Material, Raw Material Drugs and ingredients for the cure of disease, Cosmetic Raw Materials and raw materials for some types of worms that can be consumed and beneficial to humans .

Arthropod decomposers have a very important role in the decomposition process, especially in the soil. Dirt or feases from animals can lead to pollution of grasslands. Cattle feces left on the surface of the soil can kill or slow the growth of grass plants, and cause the plants around it less favored cattle. In addition, they can also place eggs for disease-carrying vectors, and are a living place for parasitic larvae in the ruminant digestive tract. However, with the presence of some species of beetles with fecal composition, they can be minimized (Shahabuddin, et al., 2005).

Table 1. Effect of Land Fauna on Soil Properties In Ecosystems

Fauna Land	Hara Cycle	Soil Structure
Mikrofauna	Set the population of bacteria and fungi Nutrient change	Affects the structure aggregate the soil and interact with microflora
Mesofauna	Set the fungus population and population of microfauna Nutrient change	Destroy the rest of the plant Produce *fecal pellets* Creating *biopore* Increases humification
Macrofauna	Destroyed crop residue, Stimulate activities microorganisms	Mixing organic matter and mineral materials Spread of organic matter and microorganisms Creating *biopore* Increases humification Produce *fecal pellets*

Source: Hendrix *et al* . 1990 *in* Coleman *et al* . 2004

3.3. Decomposition of the detergent

Detergent is an anionic surfactant with C 9 -C 15 alkyl group or a sodium or chain sodium salt of sulphonate or sulphate (RSO3-Na + and ROSO3-Na +) (1). Detergents mengandu ng 10% -30% surfactant in addition to phosphorus d an bleach. Detergents contribute about 50% of the phosphate phosph at the waters . De terjen has the ability to remove a variety of impurities sticking to cloth, household appliances, and other appliances . Therefore, detergents enter the water body as household waste or often referred to as waste domesti k. The use of detergents is continuous (continuously) and cause ketergantu ngan. Detergent waste increases sei rings by increasing the number of pendudu k. This waste makes the surface of water body covered b foam on the water surface .

Waste detergents that contain alkyl chain lin LAS IER so difficult outlined while ordinary soap alkyl chains are ABS which Berca bang so easily described. Some studies also open tikan that LAS can be described by ba kteri *Staphylococcus epidermis, Enterob acter gergoviae, Staphylococcus aureus, Pseudomonas facili, fluoroscens Pseudomonas, Pseudomonas put ida, Kurthiazopfii, and so on (Wignyanto. 2002).* LAS can also be degraded by *Bacillus sp. And Pseudomonas s Pseudomona s sp.* with the addition of nutrients N and P (Suharjono *et al*. 2007).

Dizziness katan substrate concentration will shortly ingkatkan Mer price. It was shortly unjukkan that LAS can be converted into bio-mass. The addition of a convenient substrate dise rap (nutrients) and substrate needed by the bacteria very dipe rlukan terut ama for biomass formation and sinte sis enzymes necessary for the breakdown of the detergent molecule. Mnya dala biomass rich in fat content, karbohidr at, and proteins are the results useful for continuity at the processes and k ehidupan other creatures, some another biomass is being dosage for the carbon or energy source product (Sudiana, 20 0 4).

3.4. Decomposition of pesticides

Pesticides are biocides (chemicals) that are injected to kill organisms . There are about 500 types of pesticides classified according to the group of organisms killed / controlled, among others insecticides (insects), herbicides (plants), fungicides (fungi / fungi), nematosida (nematodes), and rodentisida (rodensia). Use of pesticides without proper planning and calculation can pollute the soil and eventually kill soil-causing soil organisms (non-target groups), such as earthworms . Bacteria that survived by the treatment of pesticides can occur because the bacteria are a group that is not affected by the presence of pesticides . While on the other hand, it can be seen that a functional tuber group that will live more easily because it utilizes pesticide residues to be part of the metabolic stem. By karea it with me mperhatikan existence of microbial populations that live in environments contaminated soil pesticide then dap at used to evaluate the effect of pesticides ran CEMA (Sing and Walker, 2006).

Digrak and Ozcelik (1996) reported their results in laboratory tests that some types of bacteria from the *Actinomycetes* group could not be inhibited per plant by some commercial pesticides , whereas most of the fungi were inhibited by their growth. The recommendation is given that some *Actinomycetes* spp. can be used as alternative microbes in the handling of senobiotic crisis due to pesticide contamination in agricultural land. The utilization would be more appropriate if given to the land b ersamaan with the addition of organic matter to the soil.

Diversity of bacterial diversity in genera *Alcaligenes, Flavobacterium, Pseudomonas* and *Rhodococcus* ma mpu degrade pesticides from recalcitrant substances. Pro degradation is facilitated by the presence of functional enzymes possessed by bacteria. Pesticides as foreign components in the soil environment cause instabi litas to enzyme activity. The phosphatase and estera se as the hydrolysis enzyme produced by the microbes can break the chemical arrangement of pesticides that have unstable chains such as Carbamate, Pyrethroids, Diazinon, Dicamba, Dichloropicolinic A cid, Dimethoate, Phenylalkanoic Esther, Pyrazon oic Pyrazon, Atrazine, Linuron, Propanil, Chlorpyrif os, and 2,4-D. The ability of the oxidation process by the enzyme in the soil to the pesticide residue occurs at the ex- trunular level , then continued at the intracellular level of bacterial cells which ultimately causes the solubility rate of the residue. so that it becomes an organic element that can be absorbed by plants (Bollag and Liu, 1990). Verification of the process of pesticide reshuffling by m ikroba activity has been proven through laboratory observations. *Trametes versicolor* as the original microflora that live on the ground is able to degrade pesticides after obtaining enrichment of car bon sources from corn and corncorn powder (Ruiz-ag uilar Graciela and Rodriguez-Vaz quez Refugio, 2006). This process is coefficient of degradation due to an alien metabolic pathway , in which the enzyme degrades primarily to the polysaccharide carbon source.

The mechanism of *trichoderma* as an antagonist is where *trichoderma* fungus is able to develop faster so that it can control the place of growth as a result of the pathogen fungus is unable to grow and develop well because it is unable to compete food and place to grow. As an antibiotic the trichoderma fungus is capable of destroying the pathogen of the pathogenic fungus resulting in death in the pathogenic fungus. In addition, tricoderma includes soil saprophyte microorganisms. *Trichoderma* can decompose organic materials, such as carbohydrates, especially cellulose, the mechanism of cellulosic reshuffling by tricoderma with the help of C1, cx, and selubiase enzymes so that tricoderma is very effective for composting.

3.5. Decomposition of metal content

Metal contaminant material in the soil can be broken down by microbes with a mechanism of change in the mobility of metallic elements so it is easier to be absorbed by plants. Changes in the mobility of metallic elements by microbes can be grouped into two: redox changes of inorganic metals and changes in metallic form from inorganic to organic or vice versa specifically such a change is methylation or demethylation.

Through the oxidation of iron, sulfur, manganese and microbial arsenic obtain energy (A tlas and B ertha, 1993; santini 2000). On the other hand, the reduction of metals can take place through a process of dissimilation in anaerobic respiration, when microbes use metals as electron acceptor. The ossianion of arsenate (stolz and oremland, 1999; niggemyer, 2001), selenium stolz and oremland, 1999) chronium and uranium (Tebo and obraztsova, 1998) can be used by microbes as electron acceptor in anaerobic respiration. *Sulfurospirillum barnesii, S. Arsenophilum, Desulfotomaculum auripigmentum, Bacillus arsenicoselenatis, B. Selenitireducens, Crysiogenes arsenatis, Spingomonas spp, Pseudomonas spp, and wolinella are* known to have such systems (ahman 1994 and stolz and oremland, 1999). Microbes also have an As (V) reduction mechanism that is not associated with respiration but is associated with resistance. *Esherichia coli and Staphylococcus* aureus have such systems (Diorio, 1995). Gihring and banfield (2001) obtain a thermus that has an As (III) oxidation system and an As (V) reduction simultaneously. *Xanthomonas maltophyla is* able to reduce Cr 6+ heavy and harmless heavy metals to less harmful and less soluble Cr3 + (Blake et al., 1993) The same microbial strains may also spur other harmless metal ion transformations such as Pb2 +, Hg2 +, Au3 +, Te4 +, Ag +, and oxyanion such as SeO-4. There are also *Escherchia coli and Peudomonas* putida with the same nature (Shen and Wang, 1993). Furthermore *Shewanella algae* which is a bacteria of iron peredusi also can increase the mobility of arsenic metal (Cummings, 1999).

Methylation by microbes plays an important role in the biogeochemical cycles of metallic elements because the thermethylated compounds are often volatile. Ra ksa can be dimethylized by *Pseudomonas sp. Escherichia sp., Bacillus sp. And Clostridium sp.* into methyl mercury which is toxic and toxic (Atlas and Bertha, 1993). In addition to deformation due to the oxidation reduction process and methylation, the acidic oxidizing and sulfuric acid bacteria can dissolve arsenic, cadnium, copper, cobalt, nickel and n zinc (white, 1997 Seidel 200). In contrast, the heterotrophic anaerobic sulfate reducing bacteria can precipitate metal ions in sulphide form. Then microbiological organisms can dissolve which means increasing the availability and potential of poisoning or depositing which means lower it.

Symbiotic associations of plant-fungi have the potential to increase root surface area which can then increase the absorption of metals by roots (Khan, 2000). Vesicular arbuscular myorrhiza has been reported to increase plant uptake of Fe, Zn, and Mn (Widada, 1998). Vesicular arbuscular mycorrhiza is also thought to play a role in the ability of fake plants in arsenic hyperaccumulation Ma, et al 2001). However, there are differences in the effect of mycorrhizal presence on metal absorption. Weissenhorn and leyval (1995) show that Cd is absorbed and accumulated in the Glomus masse hyphae but occurs inhibition in removal of the metal from the fungus to the root. Heggo et al (1990) and Khan (2000) also point to inhibition of the removal of Zn and Cu metals.

Bioremediation of contaminated soil of heavy metals has been largely done by using mycorrhiza and heavy metal reducing bacteria so it can not be absorbed by plants. The results showed that the fungus had a larger contribution from bacteria, and its contribution was increasing with increasing heavy metal content (Fleibach et al., 1994). Mycorrhiza can protect plants from the excesses of certain toxic elements such as heavy metals (Killham, 1994). The mechanisms of protection against heavy metals and toxic elements given mycorrhizas can be through filtration effects, chemically deactivate or accumulation of these elements in the fungal hipa. Well-developed plants in coal waste land are found to be 'oil droplets' in the mycorrhizal vesicles. This indicates that there is a filtration mechanism, so that the toxic substances in the waste absorbed by mycorrhiza are not absorbed by the host plant.

The ectomycorrhizal fungus can increase plant tolerance to toxic metals by accumulating metals in extralytic hipa and 'extrahyphae slime' (Aggangan et al. 1998) thereby reducing absorption into host plants. The utilization of mycorrhizal fungi in the bioremediation of contaminated soil, in addition to the accumulation of the material in the hypha, can also be through the mechanism of formation of the metal complex by external hypoxic secretion (Khairani-Idris, 2008). Mycorrhizal treatments on soil contaminated by polycyclic aromatic hydrocarbons from industrial waste have an effect on clover growth, whereas with mycorrhizal the rate of clover degradation due to these aromatic compounds can be suppressed (Joner and Leyval, 2001).

The soil fauna is able to bind and accumulate heavy metals in the cells of its body. Earthworms that feed on the soil can accumulate heavy metals in their bodies such as Pb and Cd, and soil worms can serve as fauna indicators to monitor soil pollution (Martin and Bullock, 1994). Furthermore it is said that woodlice is able to accumulate the concentration of Cd in the body 50 times higher than the concentration of Cd in the soil around it, and Cu almost 36 times higher.

Table 2. Types of contaminants present in soils and degradation organisms

Contaminants	Bacteria	Mushrooms	Fauna	Information
Plastic	*Sphingomonas* *Pseudomonas* . *Ideonella sakaiensis* *Ngartea Sicum*	*Pestalotiopsis microspora* , *Phanerochaete chrysosporium*	Mealworn (caterpillar flour)	potential
Chemical fertilizer polluter soil	-	*Trichoderma*	-	-
Detergent	*Staphylococcus epidermis, Enterobacter gergoviae, Staphylococcus aureus, Pseudomonas facili, Pseudomonas fluoroscens , Pseudomonas putida, Pseudomonas aeruginosa , Kurthiazopfii,*	Algae: *Phaeophyta, Rhodophyta Chlorophyta*	-	
Pesticide	*Alcaligenes, Flavobacterium, Pseudomonas Rhodococcus, Trametes versicolor*	*Actinomycetes* spp.	-	
Metal	*Bacillus, Pseudomonas, Corynebacterium, Micrococcu Vibrio . Pseudomonas maltophilia (Hg) Pseudomonas fluorescence, Escherrichia coli, Thiobacillus ferroovidans, Clostridium sp. Xanthomonas maltophyla Shewanella alga*	*Phanerocheate chrysosporium, Both endo and ekto mycorrhizal Glomus sp.*	Earthworms Woodlice (wood lice)	Water hyacinth, spirulina sp.
Organic materials	Photosynthetic bacteria, *Lactobacillus sp.* Bacillus Brevis, Bacillus Sp) *Cyptopharga sp ., Pseudomonas sp ., Sporocyptopprice sp Clostridium sp . Ruminococcus sp .*	yeast, *Trichoderma sp ., Penicillium sp ., Aspergillus sp ., Myrothecium sp . Alternaria sp .* actinomycetes: *Micromonospora , Streptomyces ThermoacinomycetesTher mopolyspora Thermonospora .*	*Dolichoderus bituberculatus Componotus sp. Azteca sp. Apis* sp. Crickets Beetle Earthworms Ant Termite	

4. Model organisms Decomposers

In table 1. it appears that microorganisms in the form of bacteria are the most widely used organisms in almost all types of soil contaminants, then this process occurs biotransformation or biodetoxification of toxic compounds into substances that are less toxic or not toxic. When bioremediation occurs, the enzyme - enzymes produced by microorganisms modify toxic pollutants by changing the chemical structure of these pollutants, an event called biotransformation . In many cases, biotransformation leads to biodegradation , where toxic pollutants are degraded, their structure becomes uncomplicated, and eventually becomes a harmless and non-toxic metabolite. The main processes in bioremediation are biodegradation, biotransformation and biocatalyst.

The general approach to increase the speed of biotransformation / biodegradation is by: first *seeding* that is optimizing the population and activity of indigenous microbes (intrinsic bioremediation) and / or the addition of exogenous microorganisms (bioaugmentation) . Both *feeding* modifies the environment with the addition of nutrients (biostimulation) and aeration (bioventing).

The role of soil animals in the soil ecosystem is quite large in determining the quality and structure of the soil. The role of land animals in the process of reshuffling can be done directly or indirectly. Directly because it consumes and destroys organic matter, and indirectly its participation in increasing the number of soil microflora that also play a role in the process of organic material reshuffle (Deshmukh, 1992).

Ground animals carry out two different processes in the overhaul. First, the reduction is the reduction of the size of organic particles, which is due to the activity of feeding the soil animals. Second, the word bolism is the biochemical breakdown of complex organic molecules thanks to the digestive processes of fauna and soil microflora (Deshmukh, 1992). In addition to contributing to the process of overhauling organic matter and improving soil structure, soil fauna also contributes to raising cation exchange rates and contributing nitrogen to the soil (Graham, 1996).

5. Conclusion

Microorganisms, especially bacteria, play the greatest role in the process of decomposition / decomposition of contaminants present in the soil while soil fauna play a more important role in cutting or tearing or crushing contaminant materials, especially solids, whereas pollutants in the form of liquid pollutants (chemicals, pesticides, detergents and / or metal) soil fauna more acts as accumulator and bioindikator adayan polluter soil.

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