WATER QUALITY: A COMPREHENSIVE REVIEW OF ELEMENTS IN WATER QUALITY IMPROVEMENT.

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ABSTRACT

The paper presents a comprehensive review of elements in water quality improvements especially on the technology to be used. The current technology applied in the activity of water quality is one of the most important information for the relevant agencies of water. Water resources in Malaysia come in the forms of rivers, lakes, ponds and groundwater. Lakes and ponds are important water resources naturally or constructed in Malaysia. Rapid pace of the development surrounding many of the water catchment area had significant effects on the quality of water bodies. Management of water resources is becoming increasingly comprehensive demanded and complicated due to large concentrations of population, commercial activities and industries around the cities and towns, increasing water consumption, increasing water pollution, increasing land use conflicts and climate changes. Urban storm water pollution can be a large contributor to the water quality problems of many receiving waters, as runoff transports a wide spectrum of pollutants to local receiving waters and their cumulative magnitude is large. The study has reviewed the improvement elements of water quality from two different functions of materials – Titanium (IV) Oxide and Zeolite that was categorized from natural and synthesised.

Keywords: *elements, water quality, zeolite, titanium dioxide, improvements*

1. Introduction

Management of water resources is becoming increasingly comprehensive demanded and complicated due to large concentrations of population, commercial activities and industries around the cities and towns, increasing water consumption, increasing water pollution, increasing land use conflicts and climate changes. **Wei, Z. and Wang, W-K. (2011)** stated that during the process of accelerated urbanization, water resources have restricted and affected the urban development; more seriously, the process requires large quantities of water, causing the growing groundwater depression cone in the center of city and the continual falling water table. In addition, with the urban constructed area increasing, environmental and ecological problems become more noticeable.

Water quality in the open channel can be improved using application of nano-materials. Nano-materials in terms of coated powder have offered great promise for developed environmental technology products by exhibiting their enhanced reactivity towards targeted contaminants and mobility performance in the environment media. It was emphasized by **Kwaadsteniet (2011)** that a new contribution to this field is the application of nanotechnology in the design and fabrication of coatings. Nano-materials may prohibit biofouling either by repelling microorganisms through hydrophobic nano-structures or killing of microorganisms in direct contact with surfaces containing nano-biocides. **Danabas, D. and Altun, T. (2011)** also found that zeolites, one of the groups of the most important raw material in present industry, on especially environmental pollution and purification, and herbal and animal production, have attracted attention. This zeolite material has the potential to support the other materials in order to increase quality of water bodies. Innovation in the development of nanotechnology in purifying water are among the most promising. It had been researched by **Savage N. & Diallo M.S. in 2005** about the nano-materials and water purification and in their understanding, recent advances suggest that many of the issues involving water quality could be resolved or greatly ameliorated using nano-particles, nano-filtrations or other products resulting from the development of nanotechnology. The intelligence evaluation of Nanova fractal film behaviors, location, size and other characteristic is important to optimize its performance for water quality improvement. There are several intelligence approaches such as fuzzy set theory, swarm intelligence, artificial intelligence, etc applied in industrial areas.

Urban storm water pollution can be a large contributor to the water quality problems of many receiving waters, as runoff transports a wide spectrum of pollutants to local receiving waters and their cumulative magnitude is large. Therefore, evaluations of storm water runoff quantity are necessary to enhance the performance of an assessment operation and develop better water resources management and planning (**Zhang, N. and Lai, S., 2011**). The strategies was studied also by **Bian, B. & Cheng, X. J. (2011)** who was issued that urban runoff pollutants are many and varied depending on the land uses and pollutant sources present in an urban area. Typically loadings of urban pollutants are greatest from industrial and commercial areas and higher density residential areas. Although sources of specific pollutants may vary widely in urban areas, motor vehicles are recognized to be a major source of pollutants, contributing oils, greases, hydrocarbons, and toxic metals. The more cars and trucks, and the more streets and parking lots built to accommodate these vehicles, the greater the concentration of urban runoff pollutants and the more money need to spend managing these pollutants.

2. Water Quality

Water quality is a phrase to describe the chemical, physical and biological characteristics of water. Identifying good or bad water quality is not as simple as it seems because it depends on the context in which it is used. **Zhu, W. et al. (2008)** said, it is much more difficult to control the stormwater runoff. For the past 30 years there has been increasing attention and concern focused on the quality of stormwater that runs off impervious surfaces in urban environments, and what effect that runoff has on receiving water bodies and their associated biota. Pollution of urban water bodies has become an increasingly serious problem, threatening the urban ecological environment (**Bian, B. & Cheng, X. J., 2011**). In **Chauret, et. al. (1995)** research, they contended that source water management requires an understanding of the natural and human factors that impact water quality and the means to control, reduce or eliminate those impacts where possible. Important quality concerns for suppliers using surface water sources are turbidity, eutrophication and contamination from microbes, pesticides, and trihalomethane precursors. Threats to water quality include urban development and agricultural activities.

2.1 Water Treatment and Control

Source protection is the first barrier in reducing or eliminating contaminants that impact the water quality of the user. Increasing level of contaminants input and source quality deterioration place added burdens and cost on the treatment plant (**Raymond, D. L., 1999**). At the Federal level, the National Water Resources Council (**NWRC) was set up in 1998** to pursue a more effective water management, including the implementation of inter-state water transfers. To ensure sustainable water resources and efficient water supply services, the Federal Government is moving towards greater involvement in the management of water resources and water supply services, and the implementation of integrated water resources management (**Zaharaton R., 2004**).

The control of initial period rainwater plays an important role in urban water quality management since the initial period rainwater carries a greater portion of pollution loads based on **2010 study by You, X-Y. et. al.**. They agreed that currently most of research is limited to the combined drainage sewer systems, while the early rain also brings a large amount of pollutants and discharges directly to the drainage system and causes serious pollution. In addition, according to **Wiesner, M.R. (2011)**, water pollution control, groundwater remediation, and potable water treatment are among the activities being advanced by nanotechnology through the development of nano-material-based membrane technologies, adsorbents, and catalysts.

Next-generation active nano-systems, based on more complex interacting systems of nano-scale components, are being conceived to desalinate water, recover valuable materials from wastewater, and perform water quality sensing and distribution system diagnostics. According to **Zakaria, N. A, et. al. (2003),** the concept of stormwater management control is relatively new in Malaysia and a paradigm shift would be required to turn around traditional concept of drainage engineering practices based on rapid disposal towards this new concept. The new manual draws on various approach of Best Management Practices (BMPs) now is being practices worldwide, to control the quality and quality runoff through detention/retention storage, infiltration facilities, engineered water way which capable to retard the flows. In stormwater management, controlling water quantity and stormwater generated pollution at the source needs to be practised towards achieving ecologically sustainable development in urban areas in Malaysia (**NAHRIM**). Water quality control structures in BMPs shall be designed and constructed based on 40 mm runoff depth (**MSMA, 2012**) and depending on the level of pollutant the treatment at each inlet zone could be in single BMPs and/or in series/treatment train BMPs.

In the context of BMPs according to **UDFCD (2011),** sorption processes describe the interaction of waterborne constituents with surrounding materials e.g., soil, water. Absorption is the incorporation of a substance in one state into another of a different state e.g., liquids being absorbed by a solid. Adsorption is the physical adherence or bonding of ions and molecules onto the surface of another molecule. Many factors such as pH, temperature and ionic state affect the chemical equilibrium in BMPs and the extent to which these processes provide pollutant removal. Sorption processes often play primary roles in BMPs such as constructed wetland basins, retention ponds and bio-retention systems. Opportunities may exist to optimize performance of BMPs through the use of engineered media or chemical addition to enhance sorption processes.

2.2 Water Quality Standards

National Policy on the Environment which integrates the three elements of sustainable development; economic, social and cultural development and environmental conservation was formulated and approved in 2002. The policy aims at continued economic, social and cultural progress and enhancement of the quality of life of Malaysians through environmentally sound and sustainable development. In keeping abreast with the country's rapid economic development and to meet with the nation's aspiration for an improved quality of life, the National policy on the Environment serves as an important guide to all stakeholders to ensure that the environment is clean, safe, healthy and productive (**National Policy on the Environment, 2002**).

In general, there are some standards ways for measuring water quality. Water Quality Standards are the standards specifying the conditions to be achieved in a given body of water. They usually include maximum numeric limitations for a long list of identified substances, numerical limitations for conditions such as temperature and pH, and general prohibitions against deleterious conditions such as the presences of sludge, floating oil, or toxicity. More recently, they are likely to include complex formulae to prevent potential toxicity (**Malaysia Environmental Quality Report, 2010**). The methods of the measurement of Water Quality Index (WQI) are expressed in (Eq. I):

$$WQI = 0.22 \times SIDO + 0.19 \times SIBOD + 0.16 \times SICOD + 0.15 \times SIAN + 0.16 \times SISS + 0.12 \times SIpH \quad \text{(Eq. I)}$$

where;

- SIDO Sub-Index DO (in % saturation)
- SIBOD Sub-Index BOD
- SICOD Sub-Index COD
- SIAN Sub-Index NH3N\
- SISS Sub-Index SS
- SIpH Sub-Index pH

2.3 Water Quality Analysis

Water quality of watershed or stomwater runoff varies from one area to another. However, it is possible to estimate the amount of pollutant or pollutant load, if certain watershed characteristics are known. The pollutant load is defined as the mass of a given pollutant which flows from the watershed over a given period of time per acre of watershed area and expressed in unit kg/(ha-yr). This pollutant load is important on that it adversely affects the water quality of downstream water bodies. It is dissolved or suspended constituents in water are quantitatively expressed on terms of concentration, typically in mg/l. For various watershed landuses concentrations of a number of pollutants can be estimated in stormwater runoff. Pollutants such as metals will usually have higher concentrations in runoff from commercial and industrial areas. Nutrients, such as phosphorus and nitrogen show high concentrations in runoff from agricultural landuses and from area of golf courses where fertilizers are used. Residential areas also show higher concentrations of most pollutants with greater population density (**Wanielista, M., et. al., 1997**).

The analytical laboratory provides qualitative and quantitative data for use in decision making. To be valuable, the data must accurately describe the characteristics and concentrations of constituents in the samples submitted to the laboratory. In many cases, because they lead to faulty interpretations, approximate or incorrect results are worse than no result at all (**USEPA, 1979**). In this USEPA manual, advanced laboratory automation systems analyze samples automatically and use a control computer to interpret the resulting data and produce an analytical report. The term significant figure is used, sometimes rather loosely, to describe a judgment of the reportable digits in a result. When the judgment is not soundly based, meaningful digits are lost or meaningless digits are reported. On the other hand, proper use of significant figures gives an indication of the reliability of the analytical method used.

3. Water Purification

Advances in nano-scale science and engineering suggest that many of the current problems involving water quality could be resolved or greatly ameliorated using nano-sorbents, nano-catalysts, bioactive nano-particles, nano-structured catalytic membranes and nano-particle enhanced filtration among other products and processes resulting from the development of nanotechnology (**Savage, N. & Diallo, M. 2005**). In this research, four classes of nano-scale materials that are being evaluated as functional materials for water purification: metal-containing nano-particles, carbonaceous nano-materials, zeolites and dendrimers. Recent advances in this development of novel water-purification functional materials (e.g., nano-sorbents, redox and catalytically active nano-particles, nano-structured membranes and bioactive active nano-particles) and processes (e.g., dendrimer enhanced ultrafiltration). It is highlighted in Figure 1.

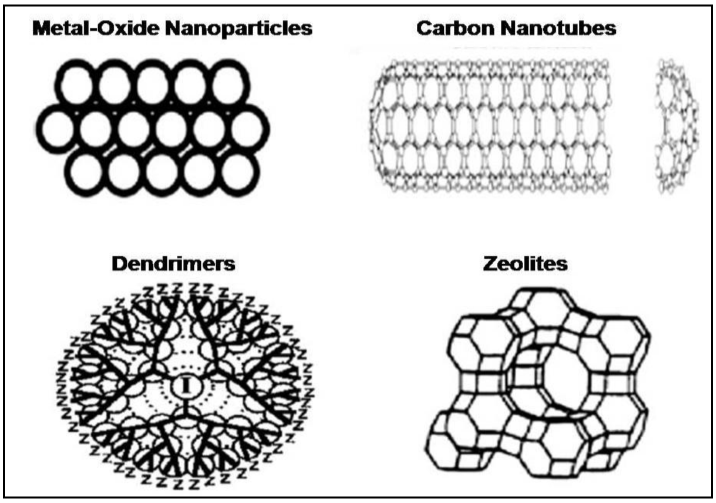

Figure 1: Selected nano-materials currently being evaluated as functional materials for water purification.

3.1 Nano-materials

From the Figure 1 of selected nano-materials, it describes sorbents are widely used as separation media in water purification to remove inorganic and organic pollutants from contaminated water, for example Zeolites; are effective sorbents and ion-exchange media for metal ions. The above study was emphasized by **Obare, S. O. & Meyer, G. J. (2004)** who stated that nano-particles have great potential as water-purification catalysts and redox active media due their large surface areas and their size and shape dependent optical, electronic and catalytic properties, i.e. titanium dioxide (TiO2). During the last decade, titanium dioxide (TiO2) nano-particles have emerged as promising photo-catalysts for water purification (**Adesina, 2004**). TiO2 nano-particles are very versatile; they can serve both as oxidative and reductive catalysts for organic and inorganic pollutants. Then, nano-materials are providing novel opportunities to develop more efficient and cost effective nano-structured and reactive membranes for water purification and desalination. (**Savage, N. & Diallo, M., 2005**).

4. Titanium Dioxide

According to **McNulty, G. S. (2007),** titanium dioxide (TiO_2) is a simple inorganic compound produced as a pure white powder. It is commonly available in two main crystal forms, anatase and rutile and typically supplied to the market in a range of package sizes or in bulk. It is the properties and uses of titanium dioxide that make it an interesting and valuable chemical and overshadow its rather mundane appearance. Titanium dioxide pigments provide whiteness and opacity to a vast range of everyday products from coatings and plastics, to inks and even cosmetics and food as shown in Figure 2. **In McNulty's** findings of the overall process of manufacture by taking an impure TiO_2 feedstock and to convert this into the pure white TiO_2 pigment. In essence the process sounds very simple but to achieve this it is necessary to chemically convert the impure TiO_2 into another chemical, separate out the impurities then to convert back to pure TiO_2 in effect a chemical purification.

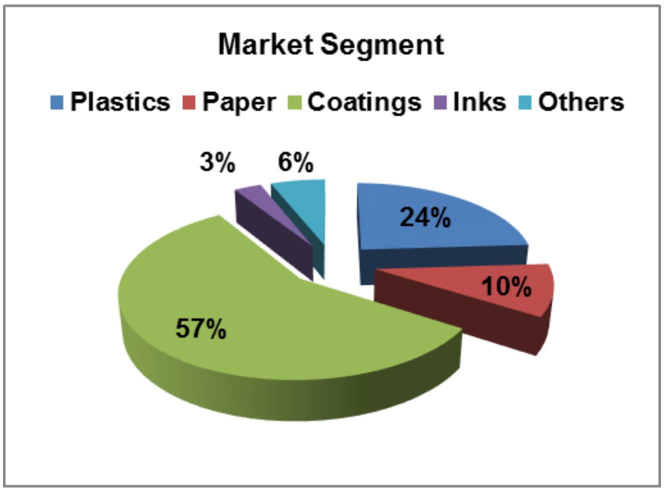

Figure 2: Market segments for titanium dioxide.

4.1 Fractal Surface of Nano-TiO_2

Nano-TiO_2 has recently been used as coating pet bottles for drinking water, waste water treatment and would be applied in stormwater quality improvement. Based on chemical nanotechnology, stone coated by TiO_2 is very versatile and offers special properties which include UV protection, anti-bacterial protection, water and dirt repellence to self-organing nano-components which form an invisible layer on the surface. According to **Kok, K. Y. et. al. (2011)**, self-cleaning decontamination on an artificial surface can be achieved via two very contrasting mechanisms at the extreme ends of solid surface wetting process (wettability) by exploiting the dynamical properties of rolling water droplets on a superhydrophobic surface (lotus effect) and water film on a photo-catalyst-coated superhydrophilic surface. Table 1 indicates the self-cleaning decontamination on an artificial surface**. Xagas, A.P, et. al. (1999**) found the improvement of the photo-catalytic efficiency passes through a net increase of the films fractality and of their specific surface area. Thus, the immobilization of the photo-catalyst in the form of a porous and high surface area inorganic oxide matrix makes further work on the subject very promising. While **DelRio, F. W., et. al. (2006)** emphasized that particulates can strongly influence interfacial adhesion between rough surfaces by changing their average separation.

Table 1: Self-cleaning decontamination on an artificial surface

Characteristic features	Self-cleaning decontaminations approaches	
	Lotus Effect	**Photo-catalytic**
Surface Morphology	Approving rough	Smooth
Behavior of water on the surface	Water stays as droplet on the surface	Water spreads out to forms sheet on the surface
Wettability	Hydrophobic (high water content angle)	Hydrophilic (low water contact angle)
Self-cleaning decontamination mechanism	Movement of water droplets	Photo-catalytic action

Sources:* ***Kok, K. Y. et. al. (2011)* *Malaysian Nuclear Agency (Nuklear Malaysia) Bangi.*

4.2 Photo-catalytic functions

Water quality can be measured in a number of different ways. Chemical or biological characteristics of the water itself can be directly measured or more indirect indicators can be used. Plants, fish, or other aquatic organisms such as phytoplankton or zooplankton can be monitored and changes in their population or distribution used as an indicator of changing water quality. Photo-catalysis has recently become a common word and various products using photo-catalytic functions have been commercialized. Among many candidates for photo-catalysts, TiO_2 is almost the only material suitable for industrial use at present and also probably in the future. This is because TiO_2 has the most efficient photo-activity, the highest stability and the lowest cost. They are chemically stable and harmless, and have no absorption in the visible region. Therefore, they have a white colour. However, the chemical stability of TiO_2 holds only in the dark. Instead, it is active under UV light irradiation, inducing some chemical reactions **(Hashimoto, K. et. al., 2005).**

5. Zeolite

Virta, R. L. (1998), Alp, E. (2005) and Tepe, Y., et. al (2005) stated that today, zeolite types are classified more than 150, as 40s of it are natural (analcime, chabazite, clinoptilolite (CL), erionite, ferrierite, heulandite, laumontite, mordenite, phillipsite, etc.) and others are synthetic; Zeolite A, X, Y, ZMS-5, etc. Zeolites are fundamentally used four aims for aquaculture applications, at the present time. These are to provide pollution control in ponds and to remove N-compounds from water of hatcheries, fish transport and aquariums. **Rafiee G. H. and Saad C. R. (2006)** investigated how zeolite performs chemically in solution. They found that he natural zeolite framework consists of a symmetrically stacked alumina and silica tetrahedral which results in an open and stable three dimensional honey comb structure with a negative charge. The negative charge within the pores is neutralized by positively charged ions (cations) such as sodium. These cations are exchangeable with certain cations in solutions such as ammonium ions.

Their findings had been supported by **Lin, H. et. al. (2010)** also involved in the research of water quality improvement found that modified zeolite with better nitrogen removal effect was used to prepare antibacterial adsorption materials for treating the secondary effluent of high concentration coliform and ammonia nitrogen. Among Ag^{+}, Zn^{+}, and Cu^{2+} ions, silver-support antibacterial adsorption materials have the best antibacterial properties nitrogen removal. From the previous research in modifying the zeolite and other raw materials, the study of integrated water resources management has taken an action to use the zeolite and flyash as better contaminants removal. It was emphasized by **Xie, L-G. et. al. (2010)** in their study indicated that the zeolite flyash had obvious stabilization effect to heavy metal i.e; Zn, Cu, Mn, and had apparent retention ability to the nutrients contents of N, P of the municipal sewage sludge.

5.1 The Structure of Zeolites

Zeolites or molecular sieves are solid crystalline with micro pores. This well-define structure is naturally available by mined in various part of world and also can be synthesised. Zeolites are well known for their cost effective and its efficiency in adsorption ability besides makes avail of ion exchanges (**Qiu, W. and Zheng, Y., 2009; Huang, H., et.al., 2010; Wang S. and Peng Y., 2010; Ibrahim H. S., et.al., 2010; Malekian R., et.al., 2011; Zhang M., et.al., 2011**). Formed as crystalline hydrated aluminium-silicates, zeolites are structured by combination of corner-sharing AlO_4 and SiO_4 tetrahedral joined. This formation which alumina and silica symmetrically stacked to each other, results in 3-dimensional honeycomb framework with having fine pores (**Malekian R., et. al., 2011**). Negative charge of the framework is due to the existent of aluminium in the neutral framework of pure silica. The negative framework is balance by mobile able cations and the cations can be substituted using standard ion exchange techniques (**Kaduk, J. A. and Faber, J.,1995**). **AlDwairi, R. A. (2009)** mentioned that isomorphous substitution of Al^{3+} with Si^{4+} in the structure will decrease the positive charge in the framework and zeolites are well known in removing ammonia from wastewater efficiently.

5.2 Natural and Synthesised Zeolites as Ammonium Removal

Ammonium is the predominant source of promulgation nitrogen pollution in hydrosphere. **Huang, H., et.al. (2010) and Zhang, M., et.al. (2011)** found that when ammonium present in large quantity in the water source, the water source will be contaminated. As the element went to the rivers or ponds, it may leads to eutrophication where algae and microorganism grows excessively and this will result to rise up oxygen demand moreover the aquatic life will be exposed to toxicity. The source of ammonium may come from municipal sewage, fertilizer factory wastewater and agriculture wastes **(Wang, S. and Peng, Y., 2010).**

In 2003, a discovery on increasing the efficiency of zeolites to absorb ammonium by the presence of organic compound is achieved by Jorgensen T.C. and Weatherly L.R. Using clinoptilolite in the research, it is observed the organic compound like lipase in lactose-based formulation and whey protein, may enhanced the uptake of ammonium ion onto clinoptilolite. There are limited ranges of solution phase concentration to observe the improvement of ammonia uptake. It is believed that the surface tension of the aqueous phase is reduced but became the point of enhancing access of the aqueous phase to the macropores of the exchanger (**Jorgensen, T.C. and Weatherly, L.R., 2003**).

In many countries, natural zeolites is used in wastewater treating facilities and function as absorbent to ammonium also for heavy metal and dyes from industrial wastewater (**Misaelides, P., 2011**). **Syafalni, S., et. al. (2012)** agreed that zeolite can efficiently reducing ammoniac nitrogen and Chemical Oxygen Demand (COD) by having high cationic exchange capacities, huge surface area and high residual carbon content. **Zhang, M., et.al. (2011)** stated that synthesis zeolites from fly ash by fusion method efficiency of removal are greater than natural zeolites. The maximum zeolites content in the former makes it a better pollutant removal. The fly ash used in the research was obtained in a power plant in Yunnan Province, China. In the fusion method, the zeolites will experience hydrothermal treatment after undergone alkaline fusion. But past research shows zeolites synthesis that only used hydrothermal method.

5.3 Natural Zeolites and Synthesised Zeolites as Heavy Metal Removal

Qiu, W. and Zheng, Y. (2009) described that a cancrinite-type of zeolite is synthesis from Class C fly ash by molten-salt method, with designation ZFA is found to be an ion exchanger to remove Pb^{2+}, Cu^{2+}, Ni^{2+}, Co^{2+} and Zn^{2+} from water. Ibrahim, H. S., et.al. (2010) studied the decreasing percentage adsorption for Cd, Cu, Pb, Ni and Zn as metal concentration in aqueous solution risen up. The maximal exchange levels obtained were as follows: $Pb^{2+}>Cd^{2+}>Cu^{2+}>Zn^{2+}>Ni^{2+}$.

Recent finding of zeolites as a coating material of adsorbers for adsorption pumps can help in many ways for examples, improve heat transfer in heat exchanger, layers of zeolites functions as antimicrobial, act as anti-corrosive coating in aggressive operating condition and environment and give better performance in the part of specific and volumetric power compare to other configuration (**Bonarccorsi, L., et. al., 2011**). They had proven that the zeolitic layer- from zeolite 4A and zeolite Y, can function as a passivation of metal surface. The zeolites that had been used are directly synthesised on metal supports for examples; stainless steel, copper and aluminium. In the other findings, kaolin is also tested by **Loiola, A.R., et.al. (2012)** to form Zeolite NaA. The research focused on producing high purity zeolites NaA from Kaolinite as a starter material, through the process of hydrothermal and thus attested its application as Ca^{2+} removal. They proven that the synthesised zeolites has higher efficiency in removing Ca^{2+} by lowering the hardness practically to zero compare to other zeolites.

5.4 Aquaculture Industry

In water circulation system of aquaculture industry, zeolites play a role as ion exchanger in removing ammonium (**AlDwairi, R. A., 2009**). Poor soil fertility due to rapid dissipation of nutrient from soil can be overcome by zeolites. This is because zeolite is a good carrier which will let nutrient to be released gradually while in torrential rain, all of the nutrient will be fully washed. Besides improve the nitrogen balance in light and sandy soils, zeolites can rise to the acid capacity in soil (**Rehakova M., et.al., 2004**). Zeolites also functioned as deodorant which can reduce the smell and moisture in stable. As several farms use anaerobic digester for organic degradation process, zeolite is found to be vital additive in mesophilic anaerobic digestion of wastewater. This is because zeolite has high capacity of microorganism immobility, the capacity for ammonia removal or ammonium equilibrium, and the possibility of reducing ammonium ions in the solution (**Montalvo, S., et. al., 2006**).

In 2006, a study done by Leggo, P. J. and his co-members who reported that an effective bio-fertilizer could help to re-vegetate land which deserted by metal pollution and reduced the erosion and dissemination of contaminant. The bio-fertilizers are produced from zeolitic tuffaceous rock that consisted of clinoptilolite and composed with organic waste. The soil is added with extra untreated zeolitic tuff for example un-ammoniated clinoptilolite and the result obtained attested very encouraging plant growth rate responds to the application of zeolites bio-fertilzer. The positive growth would be the result of active mineralization as population of chemolithotrophic nitrifying bacteria, provided initially by NH^{4+} ions which diffused from ammoniated zeolite in the bio-fertilizer increased. In this research, they also stated that when more untreated zeolitic tuff is added to substrates which already blended with the bio-fertilizer, a larger increase in plant growth is achieved. This can be explained by the changes in moisture content and the vulnerability of zeolite crystal surfaces to maintain bio-film formation.

6. Conclusion

The paper has reviewed the improvement elements of water quality from two different functions of materials – Titanium (IV) Oxide (TiO_2) and Zeolite that was categorized from natural and synthesised. TiO_2 nano-particles have emerged as promising photo-catalysts for water purification and are very versatile; they can serve both as oxidative and reductive catalysts for organic and inorganic pollutants. Water quality can be measured in a number of different ways by chemical or biological characteristics of the water itself. Water quality improvement also can be found from modified zeolite with better nitrogen removal effect that was used to prepare antibacterial adsorption materials for treating the secondary effluent of high concentration coliform and ammonia nitrogen. Natural and synthesised Zeolites enable to act as the ammonium and heavy metal removal. They also contribute the good functions to aquaculture industry which will let nutrient to be released gradually while in torrential rain, all of the nutrient will be fully washed. Indeed, TiO_2 and Zeolite mostly functioned to the element of nitrogen that they remove critically out from water body.

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