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# DAIRY OF TREATMENT PROCESS FOR WATER TREATMENT USING CERAMIC MEMBRANE FILTRATION TO PRODUCE WATER

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**Abstract**
Water is the most valuable resource on the planet earth. Each and every entity is dependent on water for survival. Good quality of water is very important in order to sustain life and ensure balanced ecosystem. With the advent of modern civilization the prominence to comforts and luxuries of epicurean man has led to the depletion of the water which is the most useful natural resource leading to water pollution. Water pollution causes water crisis and also possess potential threat to the environment throughout the globe so it is very important to prevent and control water pollution. The present work focuses on water pollution control using the combination of filtration unit and reactor unit for effective purification of wastewater. The process is widely used in domestic and industrial wastewater treatment. The ceramic membranes are reusable, eco-friendly and possesses high flux rate making it the best option for the membrane reactor system. The ceramic membranes are subjected to various characterization techniques. The effect of various parameters such as pH, temperature, sludge retention time (SRT), hydraulic retention time (HRT), pressure, sludge concentration are investigated to understand the principles. It has been discovered that the operating time decreases inconspicuously with an increase in operating pressure, thereby lowering the operating cost. The current study indicates the optimal conditions under which the process can be used to reduce operating costs without affecting the process's efficacy, as higher temperature, higher sludge concentration, and lower pH improve effluent quality. The ceramic membrane coating's performance was examined. To comprehend the fouling mechanism, the flux data were incorporated into the standard pore blocking model (SPBM) and the complete pore plugging model (CPPM). The process was found to have a minimum coefficient of regression, indicating that the foul ants that were retained in the pores were smaller than the membrane's pores. The disintegrated oxygen (DO) was found to increment. The improvement of the emanating quality as far as synthetic oxygen interest (COD), turbidity and DO means that the covered film prompts expansion in the effectiveness of lowered fired layer bioreactors. Results were obtained with coated membrane was much better compared to uncoated membranes. Thus coating of membranes helps in achieving excellent quality of effluent water.

**Keywords**:
membrane fouling modified membrane, oil contamination, oil-in-water emulsion.

## 1. Introduction

Over 1.1 billion people worldwide lack access to improved drinking water sources, and many more lack access to safe water, according to the WHO risk-based Guidelines for Drinking Water Quality (10-6 Disability Adjusted Life Years per person per year) (WHO 2006; WHO 2004). Conventional directed water structures using feasible treatment to pass safe water on to families may be numerous years away in a huge piece of the causing situation, suggesting that an impressive part of the most lamentable people ought to accumulate water outside the home and are responsible for making due (e.g., treating and taking care of) it themselves at the family level (Sobsey 2002). This service gap, which is a serious issue for public health, has been addressed by the Millennium Development Goals, which aim to reduce the proportion of people without access to safe water by half by 2015 (UN 2000). Due to unsafe drinking water, the poor bear the majority of the burden of water-borne diseases in

developing nations. Diarrhea and other diseases spread by water are especially dangerous to children, the elderly, and people with weaker immune systems.
New ways to deal with giving safe water are acquiring notoriety as a reaction to the continuous issues that are related with waterborne illnesses everywhere. Treatment of household drinking water to reduce the intake of pathogenic microbes is one of these novel strategies. Devices that can be utilized to treat water or prevent the contamination of stored water in the home are collectively referred to as "household water treatment" (HWT). These technologies are referred to as "point-of-use" (POU) technologies. These include a variety of options that give individuals and groups the ability to reduce microbial microorganisms or compound pollutants in gathered water at the point of purpose, typically at the family level. Sobsey (2006) asserts that POU technology has the potential to fill the service gap left by piped water systems, potentially enhancing health significantly in developing nations. Fewtrell, others recent meta-analyses of field trials found that household-based water quality interventions like safe storage and appropriate treatment are effective at reducing diarrheal disease. 2005; (2006)a, 2007) by Clasen and co.
There are a variety of POU water treatment technologies, some of which are supported by extensive laboratory and field studies that demonstrate that users experience effective reductions in diarrheal diseases and water-borne pathogens. Filtration utilizing permeable pottery is one promising innovation. Recent research (Clasen et al.) says that mediations are related with huge wellbeing acquires in clients contrasted with nonusers of the advances, and ongoing investigations of financially created fired filtration gadgets recommend that they in all actuality do give a successful boundary against microbial microorganisms in water (Clasen et al.). 2004a; c. Clasen (2004), Clasen et al. 2006b), Clasen and co. Despite their increasingly widespread production and distribution across the manufacturing industry, privately produced clay channels have not been thoroughly evaluated in systematic field studies to determine their microbiological viability, impact on diarrhea, or continued adequacy after some time in the field. As is the case with all candidate POU water treatment technologies, a critical evaluation of the filter's sustained impact on water quality and human health is required to inform current and potential users, implementers, and decision makers.

## 2. Literature

An estimated 1.8 million people die every year from diarrheal diseases, less than AIDS (2.8 million) but more than tuberculosis (1.6 million) and malaria (1.3 million) (WHO 2004). The majority of deaths are associated with diarrhea among children under five years of age in developing countries, who are more susceptible to malnutrition, dehydration, or other secondary effects associated with these infections (WHO 2004). Taken together, diarrheal diseases are the third highest cause of illness worldwide and the third highest cause of death in children worldwide (WHO 2004). Most diarrheal illness is associated with unsafe water, sanitation, and hygiene (Prüss-Üstün et al. 2004). Prüss et al. (2002) estimated that 4.0% of all deaths and 5.7% of the global disease burden are attributable to inadequate water, sanitation, and hygiene, including diarrheal diseases and other water-related diseases such as ascariasis and schistosomiasis, claiming 4.2% of disability-adjusted-life years (61.9 million) worldwide (WHO 2004). The study of human health risks due to WSH-related pathogen exposure has been central to the field of environmental health for over 150 years (Snow 1855), although the current global burden of diarrheal disease suggests there is still progress to be made.
An unknown percentage of the diarrheal disease burden is due solely to unsafe drinking water, since the viral, bacterial, and parasitic microbes causing diarrheal disease may also be transmitted through contaminated food, hands, fomites, or other routes (Wagner and Lanoix 1958). Drinking water quality, however, does play an important role in the risk of diarrheal diseases in humans and access to safe water is a major determinant of diarrheal disease outcomes. Diarrheagenic organisms generally

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originate in fecal matter and are transmitted through the fecal-oral route of infection (Curtis et al. 2000).
Traditionally, among the most serious waterborne risks to public health have been the bacteria Shigella spp. (bacterial dysentery), Vibrio cholerae (cholera), and Salmonella spp. (typhoid, paratyphoid fever). Although these have mostly been eliminated from the developed world through advances in drinking water treatment, sanitation, and hygiene **(Mackenbach 2007)** they and other emerging and remerging pathogens continue to compromise water quality, and thus public health, in the less developed countries.

### 2.1 Summits, targets, and initiatives

The 1980s were declared the International Drinking Water and Sanitation Decade (IDWSD) by the United Nations General Assembly, a response to the Mar del Plata Action Plan produced at the 1977 United Nations Water Conference (UN 1992). The Mar del Plata Action Plan proposed that "all peoples, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of a quality equal to their basic needs" (UN 1992). The IDWSD highlighted the problems of access which have always plagued developing countries but which have received increasingly widespread exposure from the 1960s (POST 2002). In response to the IDWSD goal of universal access to water and sanitation, the 1980s saw an increase in the number of large, supply-oriented development projects that eventually provided access to many in the developing world (UN 1992, 18.5.d). Despite progress made during this decade (1981-1990), increases in access to adequate supplies of drinking water only just matched increases in population (estimated at 750 million), leaving much work yet to be done (Mintz et al. 2001). The 1992 United Nations Conference on Environment and Development (UNCED) or "Earth Summit" in Rio de Janeiro reiterated the goal of universal access to clean water and sanitation in its principal document, Agenda 21 (UN 1992, 18.5d). The UN Millennium Declaration (2000) expressed the commitment of member states to "halve by the year 2015 the proportion of people…who are unable to reach or to afford safe drinking water" (UN 2000). The international commitment to this goal was affirmed at Johannesburg in 2002 (UN 2002). The year 2003 was declared the International Year of Freshwater by the United Nations. At its 58th session, the United Nations General Assembly adopted a draft resolution, without a vote (A/RES/58/217), proclaiming 2005 to 2015 as the International Decade for Action – Water for Life. This declaration restates the commitment of the international community to honor water and sanitation targets laid out previously in Agenda 21, the 2000 Millennium Development Goals, and the Johannesburg Plan of Implementation adopted at the of the World Summit of Sustainable Development in August 2002. The stated goal of the "Water for Life Decade" is "a greater focus on water-related issues, with emphasis on women as managers of water to help to achieve internationally agreed water-related goals".
These and similar statements by the international community suggest the existence of broad political will for increasing access to safe drinking water. The extent to which this will is translated into action at the national and local levels, however, is the critical issue (Gleick 1998). Meeting the ambitious international goals for provision of safe water will require greater investment than that currently underway, especially given the projected one-third increase in the world's population by 2050 (Short 2002). In 2003 it was estimated that reaching the Millennium Goals would require providing access to safe water for 125,000 people per day every day for the 12 remaining years until 2015 (WQHC 2003). Because this lack of access to safe water is associated with a massive burden of disease, the World Health Organization (WHO) and others are eager to explore low-cost solutions for safe drinking water access, including decentralized technologies that can improve water quality post-source. It is clear that innovative solutions are needed to increase safe water and sanitation coverage, although the best strategies for doing so are widely debated.

## 2.2 Waterborne disease

### 2.2.1 Types of water-related disease

Unsafe water, sanitation, and hygiene are associated with a wide range of infectious diseases. Water-related infections may be broadly classified into four categories by environmental transmission route: water-borne, water-washed, water-based, and water-related (Table 2.1). This typology is commonly used by engineers and public health workers in identifying appropriate measures in interventions (Bradley 1977; Cairncross and Feachem 1993). Water-borne infections are directly transferred to an individual from ingested food or drink that is contaminated by human or animal waste carrying pathogens. This classification includes typhoid fever, cholera, hepatitis A virus (HAV), hepatitis E virus (HEV), and infections of Shigella spp and E. coli 0157:H7, among others (WHO 2006). Water-borne diseases are best prevented by improvements in microbiological water quality and prevention of casual use of unimproved sources (Bradley 1977). Water-washed infections are the result of an inadequate supply of water for hygiene, facilitating the fecal-oral route of infection or transmission from one person to another (Gleeson and Gray 1997). Scabies, trachoma, and bacillary dysentery are examples (Bradley 1977). Water-washed diseases also include the water-borne diseases, since greater access to water provides for potentially better hygiene and more frequent hand washing, reducing the risk of disease (Curtis et al. 2000). Water-based infections are classified as those transmitted by contact with water that provides habitat for human parasites during some part of their life cycle. Disease is contracted either by direct skin contact or ingestion of a parasite or intermediate host living in the water. For example, schistosomes and other trematode parasites spend part of their life cycles in host organisms living in water. Schistosomiasis (bilharziasis) is caused in humans by the larval stage (cercariae) of the schistosome, which is transferred from infected snails to skin in contact with water (WHO 2006). Water-related diseases are those carried by organisms that breed in water or bite near water. Examples are the Anopheles mosquito, which carries malaria, and the Aedes mosquitoes that carry the viruses causing dengue and yellow fever (Gleeson and Gray 1997).

### 2.2.2 Diarrhea and drinking water

Improved drinking water quality, sanitation, and hygiene practices are all widely believed to be important in reducing the burden of diarrheal disease, although the relative importance of these factors is widely debated in the literature (e.g. Tumwine et al. 2002; Macy and Quick 2002; Curtis et al. 2000; Esrey et al. 1991). Up to 30% of the global diarrheal disease burden may be associated with consumption of unsafe drinking water (Macy and Quick 2002). That each of these factors is important in achieving a reduction in the water-related disease burden is widely acknowledged (WHO 2006). But given the reality of scarce international funding and widespread pressure on obtaining the maximum reduction of disease per dollar spent, it is important to identify which strategies and combinations of strategies are most efficient in achieving the goals set by the international community. Drinking water quality is now increasingly recognized as being as important as other water, sanitation, and hygiene factors in determining diarrheal disease risk (Clasen and Cairncross 2004; Fewtrell et al. 2005; Clasen et al. 2006a; Clasen et al. 2007). Previous reviews have emphasized the importance of water supply, sanitation, and hygiene improvements over drinking water quality in the reduction of diarrheal disease (Young and Briscoe 1988; Esrey et al. 1988; Esrey et al. 1991; Cairncross 1992).

## 2.3 Access to safe water

Between one and two billion people lack adequate access to improved water sources and a greater number lack access to microbiologically safe water as defined by the Guidelines for Drinking Water Quality (WHO 2006; WHO 2004; Tumwine 2002). Thus this basic human need and, according to the United Nations, basic human right, remains beyond the reach of between one-sixth and one-third of the world's population and a much higher percentage of the world's poor (UN 1992; WHO 2003; Short

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2002; Tumwine 2002). Inadequate access to safe drinking water contributes to the staggering burden of diarrheal diseases worldwide. Drinking contaminated water can also reduce personal productive time by an estimated 10%, with widespread economic effects (UN 1992). Over 440 million school days are missed annually due to WSH-related illnesses (Moszynski 2006). Problems associated with poor drinking water quality are significant barriers to development, both human and economic.
The United Nations' Millennium Development Goals (MDG) address the desperate need to provide safe drinking water to those who need it, which currently includes 40% of the population in Africa, 19% in Asia and 15% in Latin America and the Caribbean. The problem is becoming more serious as the urban populations of Africa and Asia may double in 25 years, while those of Latin America and the Caribbean are expected to increase by 50%. The MDG target of halving the population without access to safe drinking water by 2015 is sorely off pace for some areas of the world, notably sub-Saharan Africa (Anyangwe et al. 2006), but expanded access to basic needs such as clean water and adequate sanitation remains an important long-term goal.

### 2.4 Point-of-use water treatment interventions

Waterborne diseases are preventable through effective control measures (Clasen et al. 2007; Fewtrell et al. 2005). The emergence of POU water treatment technology as a strategy for safe water provision at the household level may have significant health impacts in populations lacking the means to secure safe drinking water. With the formation of the International Network to Promote Household Water Treatment and Safe Storage (INPHWTSS) and its acceptance at the Third World Water Forum in Kyoto (2003), broad-based international attention has been focused on this strategy. It is expected that the use of POU water treatment technologies will contribute to accelerated health gains from improved access to clean, safe drinking water (Sobsey 2002).
Drinking water quality improvements, such as effective household-scale water treatment, can have a significant health impact, although the relationship between measured indicators of water quality (such as E. coli) are often associated only tenuously with measured diarrheal disease outcomes (Jensen et al. 2004; Moe et al. 1991). Recent studies have shown that reductions in diarrheal disease are attainable through householdscale drinking water treatment (Clasen et al. 2004; Colwell et al. 2003; Sobsey et al. 2003; Conroy et al. 200l), leading to greater interest in these interventions worldwide (Clasen and Cairncross 2004). Previous reviews of the impacts of water supply, water treatment, sanitation, and hygiene interventions on diarrheal disease concluded that hygiene and sanitation, followed by water supply and water quality, were the most important interventions to prevent diarrheal disease in less developed countries (Esrey et al. 1985, 1986, and 1991). In these seminal reviews of field trials of water and sanitation interventions, results indicated that hygiene interventions reduced diarrheal disease by 33%, sanitation 22%, water supply 22%, water quality 17%, and multiple interventions 20%. However, household-based water treatment or other household water quality interventions were not included in these analyses. Quality of water in the home, however, has been shown to be critical to health, since this is the water that is usually used for drinking (Jensen et al. 2002). The findings of two recent meta-analyses show a much stronger protective effect for water quality interventions at the household level on diarrheal disease outcomes (Fewtrell et al. 2005; Clasen et al. 2006a). The conventional wisdom that water quality interventions, while part of the solution, were at best a component of larger interventions including hygiene education, sanitation, and an improved water supply, with the most important of these being hygiene (Curtis and Cairncross 2003), has now been refined to recognize the importance of household drinking water quality as a critical exposure variable related to diarrheal disease outcomes in developing countries.

## 3. Conclusion

Electrochemically reactive membrane filtration may hold promising potential in separation and deactivation of algae and other microbes such as viruses and bacteria and bio molecules (e.g., DNA or protein). Cross-flow membrane filtration performances (e.g., stability of permeate flux and fouling mitigation) can be improved by electrochemical activities under appropriate anodic and cathodic polarization. To avoid negative impacts (e.g., micro bubble formation on the membrane surface or membrane corrosion/decay), the level of positive and negative dc currents or effective electrode potentials should be optimized to balance pollutant degradation and membrane-fouling abatement. The presented resistance-in-series model calculations is proven to be a useful tool for computing and even predicting the dynamic increase of cake layer resistance (Rc) and thickness. Moreover, the model results better unravel the effects of electrochemical reactions on membrane filtration and fouling mitigation processes. For instance, the algal cake layer thickness and compressibility could both be affected by the anodic or cathodic reactions on electrochemical membranes. Overall, this study provides a new insight into the antifouling membrane filtration in algal separation and makes broader impacts on many other bio separation or water treatment processes.

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