All About WASTEWATER TREATMENT

A Comprehensive Guide

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Professional Help/ Advice on Waste Water, Treatment, and related topics

This eBook, commissioned by Geostar Publishing LLC, is the compilation of material written by several authors who are specialists in their respective realms of Waste Water Treatment.

If you need professional advice/ consultancy from any of these authors or the organizations they represent, we can put you in touch with them. This service is offered on a 'FREE of cost', 'non-obligatory' basis. Email us at rich@All-About-WasteWater-Treatment.com, with details of your specific requirement. Or visit: http://www.All-About-WasteWater-Treatment.com/helpdesk and post your requirement, with details, as a Ticket; we'll respond within 2 working days, normally much sooner. We'll forward your requirements to the persons concerned, and get them to reply.

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Quaking in our boots has become a way of life. And we appear to be doing it for all the wrong reasons. Oil, Weapons of Mass Destruction, terrorism - to mention a few - all keep conjuring images of the Apocalypse. These are problems you can fight or run from. And if you have the temerity, even laugh at.

But consider water; is it a renewable resource? If you said "Yes", you are right. But how long will it be before you are wrong?

It's not a widely published fact. But that's no reason why it should not be a widely acknowledged problem. The world's supply of fresh water is slowly running dry. Forty percent of the world's population is already reeling under the problem of scarcity. Most of the diseases plaguing them are water-borne. And while there is a child being born every eight seconds in America, there is a life being taken every eight seconds by some water-borne disease in other parts of the world.

Is the cause and what is the effect, is not clear as yet. Is it the lopsided distribution of fresh water that is causing climate change, or is it the climatic change that is causing this lopsided distribution? The fact is that there is a significant climate change, and as a consequence of this change, some regions are becoming drier while others are getting wetter. Some parts of the world are experiencing greater desertification, while some others are suffering category 4 and 5 hurricanes.

According to the United Nations, water is one of the most serious crises facing the world. And things are only getting worse.

Uzbekistan and Kazakhstan of the erstwhile USSR, Chile, Mexico, Paraguay, Argentina, Peru and Brazil in Latin America, parts of China and the Middle East especially Iran, and more than 25 countries of Africa are all suffering from varying degrees of desertification.

Global weather is a system gone awry. It is making poor countries poorer. Countries that are already facing drought and famine are getting less and less water. For how long can these countries run on dry?

Nowhere is the situation worse than in Africa. Almost 40 million people in 19 countries are facing imminent food shortage. Much of the livestock there, will perish. The growing water shortage will make food more scarce, potable water less accessible and water-borne diseases even more rampant. And the number of people who will suffer all this is expected to touch more than 500 million by the 2025. And the global consequence: A greater dependance on international aid.

If you say that this is an African problem, you're the original sandman. Who would have thought that 91% of New South Wales would go dry? Who would have imagined that the southwestern United States would also face similar water problems? No one can tell which part of the globe will be next.

Blame this on nature. It's most convenient. But fact is, much of the blame belongs to increasing consumption and improper usage.

At every opportunity nature reminds us by what it does and what it doesn't, that it is one of the forces we have little control over. So there's no way we can stop the rain or start it. But what we can do is become more water-efficient - get more from every gallon of water. And the only way to do this is to recycle and reuse wastewater.

Water is the giver of life. It has no substitute. And every drop counts!

Many believe that the next world war is likely to be fought on the issue of water. Even though the world is two-thirds water, most of it is not potable, and much of it is not usable for any other purpose as well.

And we are busy consuming and contaminating whatever is left of it, as if it were a non-depletable resource. In this eBook, we make an attempt to identify ways to make the best use of water, an increasingly scarce resource, by recovering it from wastewater, whether we intend to reuse the water so recovered or let it just charge our ground water reserves.

This eBook is meant for a wide cross-section of people involved in taking corrective action across the world policy makers, administrators, municipal engineers & scientists, engineers & administrators in industries vested with the responsibility to manage their wasterwater, industrial & residential property builders, academics, students and just about everyone who cares about posterity.

Before writing this eBook, a massive Survey was undertaken, covering 405 persons from all the above sections of the society, across the world. We tried to find out what they all would like covered in this eBook, and we have made an attempt to address all the relevant questions they had raised, in as much detail as practically feasible.

This is an evolving eBook, and we propose to take feedback from all you, readers of this eBook, and incorporate your suggestions, and cover whatever more you like to covered, subject to feasibililty. So, please feel free to give us your valuable feedback, addressed to

support@allaboutwastewater.com.

Also, since the readership is varied, we have the daunting task of having to cover most topics in depth, and yet make the eBook readable to all. Not all chapters may interest all readers.

We need to use jargon for the benefit of those who use them day in and day out, and yet not use jargon in the interest of those who don't know them. A water chemist, for instance, may want us to use jargon related to water chemistry, while an Engineer may find it a little heavy. We hope we have struck a fair balance; if you think otherwise, in parts or in full, please give us your feedback and suggestions.

We have much bigger plans, and hope to be able to accomplish them with your help. Since we reach this eBook across to you through electronic means, we would keep you informed of our acitivites as they take shape.

2.1 Acidity

Can water be acidic in taste? Most natural water, domestic wastewater and many industrial wastewater are buffered by a carbon dioxide-bicarbonate system. Acid waters are of concern because of their corrosive characteristics and the expense involved in removing or controlling the corrosion-producing substances. Mineral acids are measured by titration to a pH of about 3.7.

2.2 Alkalinity

When will the water be alkaline in taste? The alkalinity of natural water is primarily due to the salts of weak acids. Although, weak or strong bases may also contribute. Natural water contains appreciable amounts of carbonate and hydroxide alkalinity. Higher alkaline waters are usually unpalatable. Alkalinity is measured volumetrically by titration with N/50 or 0.020 N H_2SO_4.

2.3 Hardness

Water is more often hard. Do you agree? Hardness is caused by metallic ions that are capable of reacting with soap to form a precipitate. Calcium bicarbonate, magnesium sulfate, strontium chloride, ferrous nitrate and manganese silicate are the major sources for hardness in wastewater. Hardness is determined using ethylene-di-amine tetra acetic acid (EDTA) or its sodium salts as the titrating agent.

2.4 Chloride

Chloride is a major contributor to the 'total dissolved solids' in water/wastewater. The chloride content of water/wastewater increases as its mineral content increases. Chlorides at a concentration above 1000 mg/l give a salty taste, which is objectionable to many people. Chloride concentration of wastewater is estimated by Mohr’s method using silver nitrate with potassium chromate as an indicator.

2.5 Biochemical oxygen demand (BOD)

The strength of wastewater is judged by BOD. This is defined as the amount of oxygen required by bacteria while stabilizing the organics in wastewater under aerobic conditions, at a particular time and temperature. This can be referred as BOD_5, which accounts for 70% of the total BOD. The measurement of BOD is based on the principle: determination of dissolved oxygen content of water/wastewater on the first day and dissolved oxygen content on the fifth day ('5' in BOD5 indicates this). The difference in dissolved oxygen concentrations between first day and fifth day is expressed as BOD of wastewater.

2.6 Chemical oxygen demand (COD)

What does COD of wastewater mean? This reflects the concentration of organic compounds present in wastewater. This measures the total quantity of oxygen required for oxidation of organics into carbon dioxide and water. The oxidation of organics in wastewater is carried out by the action of strong oxidizing agents. Generally, acidified potassium dichromate is used as an oxidizing agent for the determination of COD. Silver sulfate is used as the catalyst for the oxidation of organics in wastewater during the determination of COD. Mercuric sulfate is added to control the interference of chloride in the estimation of COD. The method consists of adding a known concentration of potassium dichromate (added with silver sulfate and mercuric sulfate) into wastewater containing organic compounds to be oxidized in the heating condition. After oxidation, the excess potassium dichromate is back titrated with ferrous ammonium sulfate.

2.6.1 Importance of COD:

Estimation of COD expresses the total concentration of organics present in the wastewater. This measures approximately the theoretical oxygen demand of wastewater. The determination accounts for about 95% of the organic concentration in wastewater. This forms about 1.43 times the BOD of wastewater. BOD to COD ratio reveals the treatability of wastewater. If the ratio of BOD/COD is above 0.5, the wastewater is considered to be highly biodegradable. If the ratio is less than 0.3, the wastewater is deemed to undergo a chemical treatment before the routine biological treatment.

2.7 Ammonia nitrogen:

This is derived from ammonium compounds and organic compounds in wastewater by aerobic or anaerobic digestion. Un-ionized ammonia is toxic to fish life. Free ammonia, in concentration above about 0.2 mg/l can cause fatalities to fish. Ammonia toxicity is not a problem in receiving waters with pH below 8.0. This can be estimated by distillation of wastewater at pH above 9. The ammonia liberated is neutralized in sulfuric acid. The excess sulfuric acid is back titrated with alkali. The estimation of ammonia can be done by any other methods like nesslerization or digestion.

2.8 Nitrate nitrogen:

Nitrate nitrogen in drinking water with high nitrate content often causes methemoglobinemia (blue-baby disease) in infants. The maximum concentration should not be allowed to exceed 45 mg/l. Nitrate is reduced to nitrite in digestive system which, in turn, attacks the hemoglobin in infants resulting in methemoglobinemia. Nitrate nitrogen can be estimated by measuring the optical density at 220 nm and 275 nm in spectrophotometer.

2.9 Nitrite

Nitrite can also interact with amine chemically or enzymatically to form nitrosoamines which are carcinogens. This is measured by colorimetric determination using sulfanilamide.

2.10 Sulfate

Sulfate is one of the major anions occurring in natural waters. Sulfates form hard scales in boilers and heat exchangers. Sulfate assumes significance in water and wastewater, as it is associated with odor and sewer-corrosion problems resulting from the reduction of sulfate into hydrogen sulfide under anaerobic conditions. Sulfate in water or wastewater can be estimated by precipitation with barium chloride, acidified with hydrochloric acid.

2.11 Phosphates

Most of the synthetic detergents designed for the household applications contain large amounts of polyphosphates as builders. Many of them contain 12-13% phosphorous or over 50% poly-phosphates. The organisms involved in the biological