Acid rain critical

Introduction

Acid rain has become an environmental concern of global importance within the last decade. With the increasing environmental awareness of the " unhealthy" condition of our planet earth the concern about acid rain has not lessened. In brief, acid rain is rain with pH values of less than 5. 6. When dealing with acid rain one must study and understand the process of making Sulfuric acid.

In this project we will take an in depth look into the production of sulfuric acid, some of its uses and the effects of it as a pollutant in our environment. Sulfuric Acid Industry in Ontario Among the many plants in Ontario where sulfuric acid is produced, there are three major plant locations that should be noted on account of their greater size. These are: Inco. – Sudbury Noranda Mines Ltd.

– Welland Sulfide – Ontario There are a number of factors which govern the location of each manufacturing plant.

Some of these factors that have to be considered when deciding the location of a Sulfuric Acid plant are: a. Whether there is ready access to raw materials; b. Whether the location is close to major transportation routes; c.

Whether there is a suitable work force in the area for plant construction and operation; d. Whether there is sufficient energy resources readily available; e. Whether or not the chemical plant can carry out its operation without any unacceptable damage to the environment. Listed above are the basic deciding factors that govern the location of a plant. The following will explain in greater detail why these factors should be considered. 1) Raw Materials The plant needs to be close to the raw materials that are involved in the production of sulfuric acid such as sulfur, lead, copper, zinc sulfides, etc.

. 2) Transportation A manufacturer must consider proximity to transportation routes and the location of both the source of raw materials and the market for the product.

The raw materials have to be transported to the plant, and the final product must be transported to the customer or distributor. Economic pros and cons must also be thought about.

For example, must sulfuric plants are located near the market because it costs more to transport sulfuric acid than the main raw materials, sulfur. Elaborate commission proof container are required for the transportation of sulfuric acid while sulfur can be much more easily transported by truck or railway car. 3) Human Resources For a sulfuric acid plant to operate, a large work force will obviously be required. The plant must employ chemists, technicians, administrators, computer operators, and people in sales and marketing. A large number of workers will also be required for the daily operation of the plant.

A work force of this diversity is therefore likely to be found only near major centres of population. 4) Energy Demands Large amounts of energy will also be required for the production of many industrial chemicals. Thus, proximity to a plentiful supply of energy is often a determining factor in deciding the plant’s location. 5) Environmental Concerns Most importantly, however, concerns about the environment must be carefully taken into consideration.

The chemical reaction of changing sulfur and other substances to sulfuric acid results in the formation of other substances like sulfur dioxide.

This causes acid rain. Therefore, there is a big problem about sulfuric plants causing damage to our environment as the plant is a source of sulfur emission leading to that of acid rain. 6) Water Supplies Still another factor is the closeness of the location of the plants to water supplies as many manufacturing plants use water for cooling purposes.

In addition to these factors, these questions must also be answered: Is land available near the proposed site at a reasonable cost? Is the climate of the area suitable? Are the general living conditions in the area suitable for the people involved who will be relocating in the area? Is there any suggestions offered by governments to locate in a particular region? The final decision on where the sulfuric acid plant really involves a careful examination and a compromise among all of the factors that have been discussed above. Producing Sulfuric Acid Sulfuric acid is produced by two principal processes-the chamber process and the contact process.

The contact process is the current process being used to produce sulfuric acid. In the contact process, a purified dry gas mixture containing 7-10% sulfur dioxide and 11-14% oxygen is passed through a preheater to a steel reactor containing a platinum or vanadium peroxide catalyst.

The catalyst promotes the oxidation of sulfur dioxide to trioxide. This then reacts with water to produce sulfuric acid. In practice, sulfur trioxide reacts not with pure water but with recycled sulfuric acid.

The reactions are: $2SO_2 + O_2$ * $2SO_3$ $SO_3 + H_2O$ * H_2SO_4 The product of the contact plants is 98-100% acid. This can either be diluted to lower concentrations or made stronger with sulfur trioxide to yield oleums. For the process, the sources of sulfur dioxide may be produced from pure sulfur, from pyrite, recovered from smelter operations or by oxidation of hydrogen sulfide recovered from the purification of water gas, refinery gas, natural gas and other fuels. Battery Acid Industry Many industries depend on sulfuric acid. Among these industries is the battery acid industry. The electric battery or cell produces power by means of a chemical reaction.

A battery can be primary or secondary.

All batteries, primary or secondary, work as a result of a chemical reaction. This reaction produces an electric current because the atoms of which chemical elements are made, are held together by electrical forces when they react to form compounds. A battery cell consists of three basic parts; a positively charged electrode, called the cathode, a negatively charged electrode, called the anode, and a chemical substance, called an electrolyte, in which the electrodes are immersed. In either a wet or dry cell, sufficient liquid must be present to allow the chemical reactions to take place.

Electricity is generated in cells because when any of these chemical substances is dissolved in water , its molecules break up and become electrically charged ions. Sulfuric acid is a good example. Sulfuric acid, H_2SO_4, has molecules of which consist of two atoms of hydrogen, one of sulfur and four oxygen.

When dissolved in water, the molecules split into three parts, the two atoms of hydrogen separate and in the process each loses an electron, becoming a positively charged ion ($H+$). The sulfur atom and the four atoms of oxygen remain together as a sulfate group ($SO4$), and acquire the two electrons lost by the hydrogen atoms, thus becoming negatively charged ($SO4–$).

These groups can combine with others of opposite charge to form other compounds. The lead-acid cell uses sulfuric acid as the electrolyte. The lead-acid storage battery is the most common secondary battery used today, and is typical of those used in automobiles. The following will describe both the charging and discharging phase of the lead-storage battery and how sulfuric acid, as the electrolyte, is used in the process.

The lead storage battery consists of two electrodes or plates, which are made of lead and lead peroxide and are immersed in an electrolytic solution of sulfuric acid. The lead is the anode and the lead peroxide is the cathode. When the battery is used, both electrodes are converted to lead sulfate by the following process. At the sulfate ion that is present in the solution from the sulfuric acid. At the cathode, meanwhile, the lead peroxide accepts two electrons and releases the oxygen; lead oxide is formed first, and then lead joins the sulfate ion to form lead sulfate. At the same time, four hydrogen ions released from the acid join the oxygen released from the lead peroxide to form water.

When all the sulfuric acid is used up, the battery is “ discharged” produces no current.

The battery can be recharged by passing the current through it in the opposite direction. This process reverses all the previous reactions and forms lead at the anode and lead peroxide at the cathode. Proposed Problem i) The concentration of sulfuric acid is 0. 0443 mol/L. The pH is: No.

mol of hydrogen ions = 0. 0443 mol/L x 2 = 0. 0886 mol/L hydrogen ions pH = – log [H] = – log (0. 0886) = – (-1. 0525) = 1.

05 Therefore, pH is 1. 05. ii) The amount of base needed to neutralize the lake water is: volume of lake = 2000m x 800m x 50m = 800, 000, 000 m3 or 8×108 m3 since 1m3= 1000L, therefore 8×1011 L 0. 0443 mol/L x 8×1011 = 3.

54 x 1010 mol of H2SO4 in water # mol NaOH = 3. 54 x 1010 mol H2SO4 x 2 mol NaOH 1 mol H2SO4 = 7. 08 x 1010 mol of NaOH needed Mass of NaOH = 7. 08 x 1010 mol NaOH x 40 g NaOH 1 mol NaOH = 2.

83 x 1012 g NaOH or 2. 83 x 109 kg NaOH Therefore a total of 2. 83 x 1012 g of NaOH is needed to neutralize the lake water. iii) The use of sodium hydroxide versus limestone to neutralize the lake water: Sodium hydroxide: Sodium hydroxide produces water when reacting with an acid, it also dissolves in water quite readily.

When using sodium hydroxide to neutralize a lake, there may be several problems. One problem is that when sodium hydroxide dissolves in water, it gives off heat and this may harm aquatic living organisms.

Besides this, vast amounts of sodium hydroxide is required to neutralize a lake therefore large amounts of this substance which is corrosive will have to be transported. This is a great risk to the environment if a spill was to occur. The following equation shows that water is produced when using sodium hydroxide. $2NaOH + H_2SO_4$ * $Na_2 SO_4 + 2H_2O$ Limestone: Another way to neutralize a lake is by liming.

Liming of lakes must be done with considerable caution and with an awareness that the aquatic ecosystem will not be restored to its original pre-acidic state even though the pH of water may have returned to more normal levels. When limestone dissolves in water it produces carbon dioxide.

This could be a problem since a higher content of carbon dioxide would mean a lowered oxygen content especially when much algae growth is present. As a result, fish and other organisms may suffer. Limestone also does not dissolve as readily as sodium hydroxide thus taking a longer period of time to react with sulfuric acid to neutralize the lake. The equation for the neutralization using limestone is as follows: $Ca CO_3 + H_2SO_4$ * $CaSO_4 + H_2O$.

iv) The effect of the Acid or excessive Base on the plant and animal life: You will probably find that there aren't many aquatic living organisms in waters that are excessively basic or acidic. A high acidic or basic content in lakes kill fishes and other aquatic species. Prolonged exposure to acidic or excessively basic conditions can lead to reproductive failure and morphological aberration of fish.

A lowered pH tends to neutralize toxic metals. The accumulation of such metals in fish contaminates food chains of which we are a part as these metals can make fish unfit for human consumption. Acidification of a lake causes a reduction of the production of phytoplankton (which is a primary producer) as well as in the productivity of the growth of many other aquatic plants.

In acidic conditions, zooplankton species will probably becompletely eliminated. In addition, bacterial decomposition of dead matter is seriously retarded in acidified lake waters. Other effects of acidic conditions arean overfertilization of algae and other microscopic plant lifecausing algae blooms. Overgrowth of these consumes quickly most of the oxygen in water thus causing other life forms to die from oxygen starvation.

When there are excessive base or acid in waters, not only do aquatic organisms get affected but animals who depend on aquatic plants to survive will starve too, since few aquatic plants survive in such conditions. Therefore each organism in the aquatic ecosystem is effected by excessive basic or acidic conditions because anything affecting one organism will affect the food chain, sending repercussions throughout the entire ecosystem.

v) The factors that govern this plant’s location, if this plant employs 40% of the towns people: The major factors that would govern this plant’s location would be whether there is ready access to raw materials; whether the location is close to major transportation routes; whether energy resources are readily available and if there is an adequate water supply in the area.

Since this plant would employ 40% of the towns people, the plant should be close to the town while still far enough so that in case of any leakage of the plant, the town will be within a safe distance of being severely affected. The factor of whether the general living conditions in the area are suitable for the workers should also be considered as well. Additional Comments a) The situation of pollution in the Great Lakes and process being used to start cleaning it up-comments: Everyday, roughly 3630 kilograms of toxic chemicals enter the lakes, nearby land and air. Pollution of the Great Lakes has become an increasingly serious problem.

Just in Lake Ontario, hundreds of thousands of tons of contaminants have been deposited over the years. These include DDT, PCBs, mercury, dioxins and mirex, a pesticide. About 4. 6 million people depend on Lake Ontario alone for drinking water.

The environmental problem of greatest concern to Lake Ontario neighbours is water-discharged toxic chemicals and industrial air pollutants.

Not only is this occurring in Lake Ontario but the other Great Lakes as well. The lakes probably have all these poisonous chemicals in them: salts drained from urban streets, coliform bacteria from the sewage civilization plus a selection of substances such as phosphorus, polychlorinated biphenyls and heavy metals. It is reported that the toxic chemicals in the Great Lakes basin are a health risk linked to brain damage, birth defects and cancer.

All the predator species at the top of the food chain have shown health problems as a result of toxic chemicals building up in their bodies. Chemicals that exist in low levels in the air and water accumulate as they move up through the food chain. At present 35 million humans who live around the horridly polluted five Great Lakes face increasing health risks from environmental contaminants.

Millions of people in the Great Lakes are exposed to hazardous chemicals. They drink them in the contaminated water, eat them concentrated in the flesh of the fish and breathe them in the air. Mulroney said that the risks are too high and that we cannot afford any more risks.

He said pollution problems could be fought under a three-stage plan over the next decade: 1) A " toxic freeze" banning new polluters from putting up pipes or smokestacks in the region 2) An attack on " non-point sources" of pollution, such as run-off from streets and farms where groundwater is loaded with pesticides. 3) A crackdown on existing polluters when their smoke and sewer-discharge permits come up for renewal, requiring them to scale down their pollution. Consumers can also help by demanding pesticide-free food. International agreements have been made to clean up the Great Lakes.

Canada's federal Conservative government has announced in 1989 to spend $125 million over five years on Great Lakes cleanup.

By one estimate, it may cost as much as $100 billion to retrieve the purity of the Great Lakes once had. b) The treatment of water for drinking and water purifiers one can purchase-comments: As the people's uncertainty to the quality of our drinking water increases, many more people are buying water treatment devices and purifiers. Even though most treated tap water is fit to drink, people are losing faith in the government to keep it that way. therefore purifier leave become increasingly popular among consumers. However each of the most popular cleansing methods has some disadvantages.

Many filters use some form of “ activate” carbon. However, few carbon filters alone do a very good job of reducing heavy metals such as lead even though the smallest sink-tap charcoal strainer will make cloudy water look and taste a bit better. Distillation units turn water to steam and recondense it to a cleaner state.

This process has its disadvantages, too for they can also pass along harmful chemicals with low boiling points into the water. Another water treatment device is the reverse-osmosis device which uses sophisticate membranes to separate pure water from impure.

Even though this is effective, three gallons of water for every good one produced is generally wasted. Some machines zap germs with lethal doses of ultraviolet light. A specific example of a water filter is the NSA 3000HM high density filter. This filtration unit is designed to remove lead, iron, sulfur and manganese from your drinking water supply. Still another example is a water treatment system called the NSA Bateriostatic water treatment system.

This system removes chlorine, bad taste and odours, reduces undissolved particles (sediment, discolouration, etc.) and inhibits bacteria growth.

Each of these processes can reduce impurities in your water supply and many machines as suggested by the above examples combine several approaches. c) BRIEF OUTLINE OF THE KEY EVENTS IN THE U.

S.-CANADA RELATIONS WITH RESPECT TO CLEANING UP THE GREAT LAKES: 1972: the U. S. chairman of the International Joint Commission, announced to study to determine the polluting effects on the Great Lakes urban development and agricultural land use, find remedies and estimate cleanup costs; Canada and the United States signed a Great Lakes Quality Agreement.

1974: Canadians say the cleanup financed by Washington is already running far behind the schedule envisaged when the agreement was signed. 1978: Canada and the United States agreed to the goal of zero discharge of pollution.

1987: the goal made in 1978 is made again, this means both countries agreed to work toward completely eliminating persistent toxic pollutants, not just the amount being discharged by industry; Mulroney also proposed that the U. S. slash industrial sulfide and nitrogen oxide emissions by half before 1994. The Canada-U.

S. International Joint Commission meets every two years to discuss pollution and other issues concerning the Great Lakes, At present, they are making a ten-year headline for the Great Lakes to be cleaned up.

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