Thermal Pollution

Sources and Effects and control measures

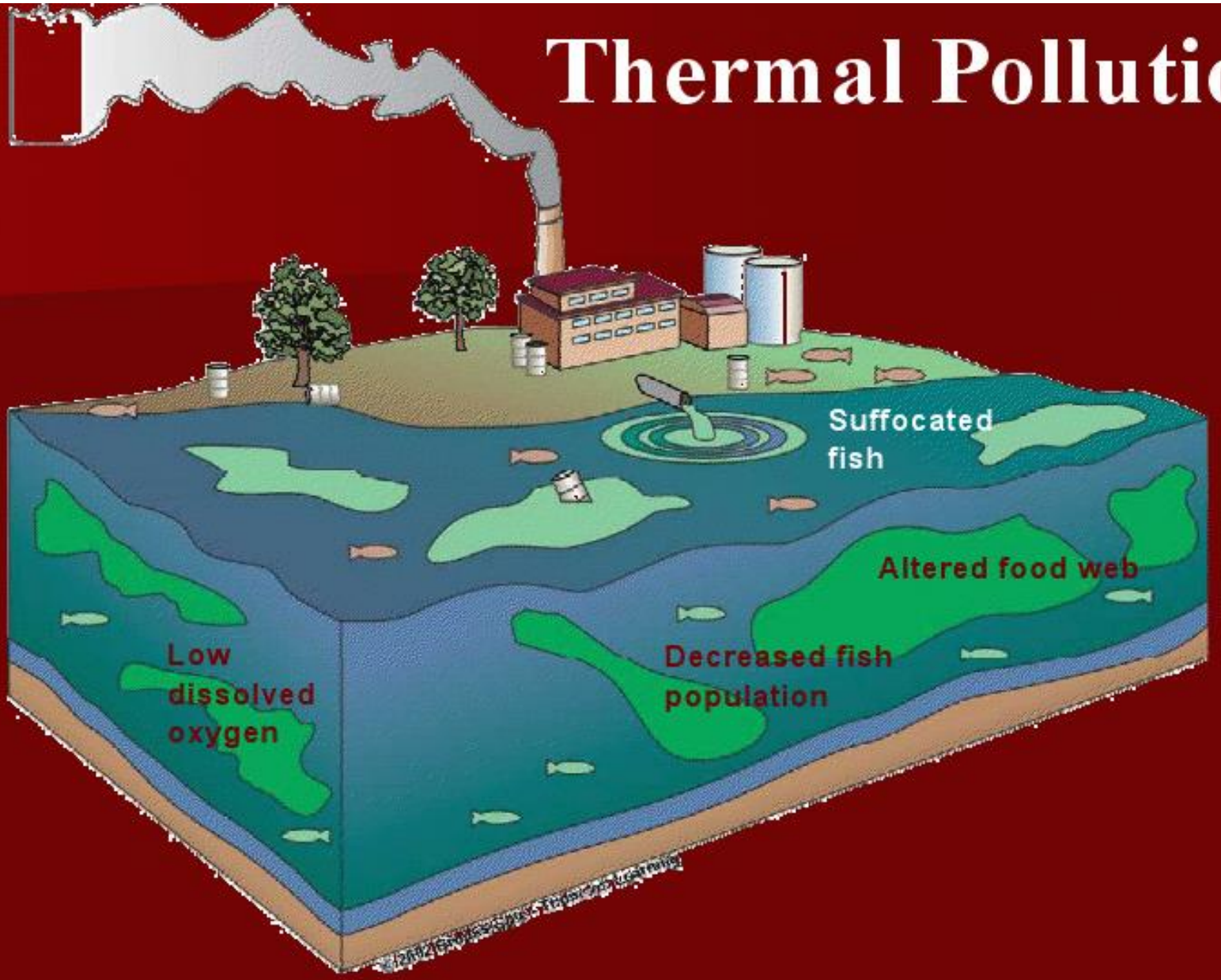
INTRODUCTION

- Thermal Pollution is the harmful increase in water temperature in streams, rivers, lakes, or occasionally, coastal ocean waters.

- It is the degradation of water quality by any process that changes ambient water temperature.

- A temperature increase as small as 1 or 2 Celsius degrees (about 2 to 4 Fahrenheit degrees) can kill native fish, shellfish, and plants, or drive them out in favor of other species, often with undesirable effects.

Thermal Pollution



SOURCES

The major sources of thermal pollution are discharge of h eated water or hot waste material into water bodies

Main causes are :

- Nuclear power plant.
- Industrial effluents
- Domestic sewage
- Hydro-electric power
- Coal fired power plants
- Thermal shock

Other causes are :

- Deforestation
- Soil erosion

Nuclear Power Plants

✓ Nuclear power plants use water as a cooling agent.

✓ After the water is used, it is put back into a water supply at 9-20^{o}C warmer .

✓ Emission from nuclear reactors increase the temperature of water bodies.

Coal Field Power Plants

✓ Coal is utilized as a fuel.

✓ Condenser coils are cooled with water from nearby lake or river.

✓ The heated effluents decrease the DO of w ater.

✓ Damages the marine organisms.

Industrial Affluents

✓ Discharged water from steam-electric power industry using turbo gener ators will have a higher temperature ranging from 6 -9˚C than the receiving water.

✓ In modern stations, producing 100 MW, nearly one million gallons are discharged in an hour with increase in temperature of the cooling water passing by 8 to 10 ˚C .

Sewage

✓ Sewage is commonly discharged into lakes, canals or streams.

✓ Municipal sewage normally has a higher temperature than the receiving water.

✓ Increase in temperature of the receiving water decreases the dissolved oxyg en of water

Deforestation

✓Streams and small lakes are naturally kept cool by trees and other tall plants

✓that block sunlight. People often remove this shading vegetation in order to harvest the wood in the trees, to make room for crops, or to construct buildings , roads, and other structures.

Soil Erosion

✓ Removal of vegetation far away from a stream or lake can contribute to ther mal pollution by speeding up the erosion of soil into the water, making it muddy , which increases the light absorbed .

Thermal Shock

✓When a power plant first opens or shuts down for repair or other causes, fish a nd other organisms adapted to particular temperature range can be killed by the abrupt change in water temperature known as "thermal shock."

EFFECTS

- Elevated temperature typically decreases the level of dissolved oxygen of water.

- Increases the metabolic rate of aquatic animals, as enzyme activity, resulting in these organisms consuming more food in a shorter time , which increases their need for oxygen.

- High temperature limits oxygen dispersion into deeper waters, contributing to anaerobic conditions.

- This lead to increased bacteria levels when there is ample food supply. Many aquatic species will fail to reproduce at elevated temperatures.

- Primary producers are affected by warm water because higher water temperature increases plant growth rates, resulting in a shorter lifespan and species over population.

Biotic Effects

Changes in the environment may also result in a migration of organisms to another, more suitable environment, and tin-migration of organisms that normally live in warmer waters. As a result , there arises a problem o f compromising food chain, which results in reduction of biodiversity.

Changes of even 1 or 2 degrees Celsius can cause significant changes in organism metabolism and other adverse cellular biology effects. Principal adverse changes can include rendering cell walls less permeable to osmosis, coagulation of cell proteins, and alteration of enzyme metabolism. These cellular level effects can adversely affect mortality and reproduction

CONTROL MEASURES OF THERMAL POLLUTION

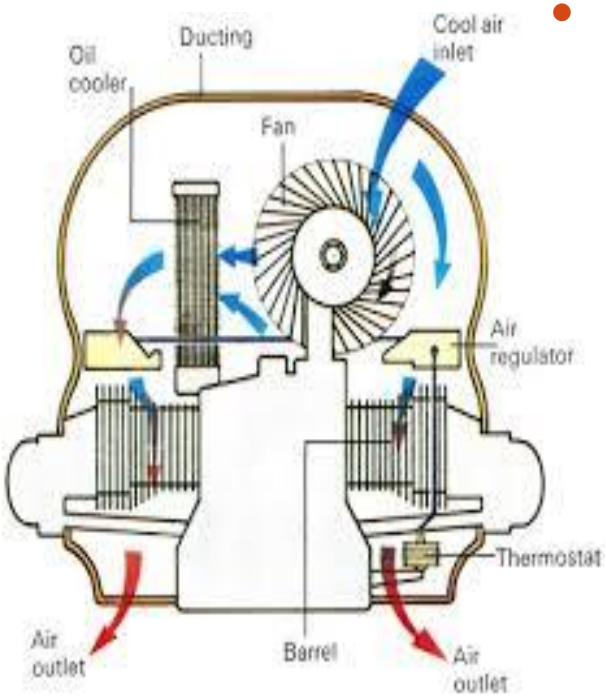
1.Cooling towers and artificial lakes

- Industries which generate excess heat release the heated water into water channels. This water affects the normal temperature of the water bodies affecting the ecosystem adversely. An economic solution to the problem is using cooling ponds to let the heated water lose its temperature with time. Once the temperature is in equilibrium with the surroundings, it can be released into water bodies or recycled for further use. Artificial lakes work on the same principle and can help check thermal pollution by using natural processes to minimize heat transfer to natural water bodies.

2.Save Electricity

- Electricity was never a cheap commodity. Its production involves burning of coal in thermal power plants, which is used to heat up water and in turn, the steam produced is used to power turbines which generate electricity. However, the waste heat generated from thermal power plants is in large quantities and can cause excess thermal pollution. Hence, when we save electricity, we indirectly prevent thermal pollution.

3.Use of alternative cooling agents other than water.



- A majority of our infrastructure surrounds around the use of water as a coolant. The primary reason behind it is the ease of availability and easy disposal once the cooling purpose is fulfilled. However, the heated water disturbs the ecosystem of water bodies. Hence, emphasis should be laid on using coolants other than water. Air-cooled systems are the best alternative to water-based cooling systems. For smaller units, oil-based cooling systems would fulfill the task of cooling. Well, the oil is reusable and can be used for multiple cooling cycles.

4.Release heated water in less vulnerable regions

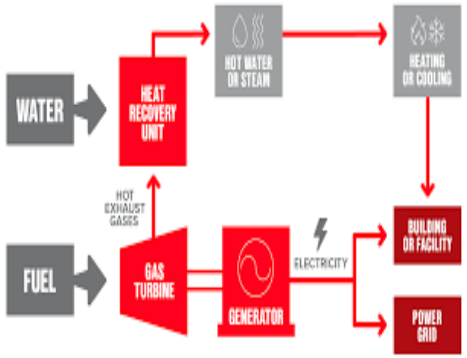
- Several heavy scale industries are established close to water bodies. It helps with an easy discharge of waste in an economic way. However, several natural water bodies have a sensitive ecosystem. In other words, the vegetation of the particular water body would not survive a sudden rise in temperature. Hence, steps should be taken to prevent the release of heated water in less vulnerable regions.

5.Tree planting along the shorelines

The most economic way to control any form of pollution is affo restation. Tree plantation along shorelines would help the soil to retain its texture and productivity. Additionally, the trees wo uld help control air pollution and result in a better and more st able ecosystem.

6. Cogeneration

- Cogeneration works on the principle of ‘reuse’, where the residue heat from the generation of electricity is used to provide heat to homes and buildings. Hence, Cogeneration or Combined Heat and Power is an effective measure to prevent thermal pollution.



7.Use of alternative sources of energy

Electricity generation through conventional thermal power pl ants is the major source of pollution. Thermal power plants us e steam-driven turbines to generate electricity. Hence, it resul ts in thermal pollution. As a precaution, solar energy or hydro power plants could be used to prevent the thermal pollution i n the production of electricity.

8.Environmental Awareness

- In the present set of conditions, the issues of thermal pollution are set to increase over a period. The only viable solution would be raising environmental awareness and making people familiar with the ill-effects of rapid industrialization.