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TOPIC - THERMAL POLLUTION

CONTENTS



INTRODUCTION



SOURCES OF
THERMAL POLLUTION



EFFECTS OF THERMAL
POLLUTION



CONTROL OF
THERMAL POLLUTION

INTRODUCTION

- Thermal pollution in the broadest sense can be defined as the abrupt change in ambient temperature of a natural water body by any human induced processes.
- Thermal pollution is any deviation from the natural temperature in a habitat and can range from elevated temperatures associated with industrial cooling activities to discharges of cold water into streams below large impoundments.

SOURCES OF THERMAL POLLUTION

1. NATURAL PROCESSES

- Volcanic eruption or geothermal activities under the ocean or land could increase thermal pollution.
- The lava (molten rocks) could lead to a sharp rise in the temperature of water.



2. PRODUCTION AND MANUFACTURING PLANTS

- Coal fired power plants, natural gas plants, textiles, paper & pulp industries, etc., utilize a huge amount of water as a cooling agent in lowering the temperature of machinery such as generators & heat engines.
- The heated water is then released back to the source which is either a river or an ocean, and in most cases causing a disturbance in the thermal equilibrium.



Thermal power station

3.DEFORESTATION:

- Streams and small lakes are naturally kept cool by trees and other tall plants that block sunlight.
- In the absence of trees, the water bodies are exposed to more sunlight and absorb heat, which raises the normal temperature of the water.



4. SOIL EROSION:

- Removal of vegetation far away from stream or lake can contribute to thermal pollution by speeding up the erosion of soil into the water, making it muddy, which increases the absorption of light.



5. DOMESTIC SEWAGE

- Sewage water which enters bodies of water with minimal or no treatment will have higher organic temperature, and this can change temperature of receiving water.
- Increase in temperature of the receiving water decreases the DO of water and can result in deaths of aquatic life.



6.WATER RUNOFF FROM PAVED SURFACES:

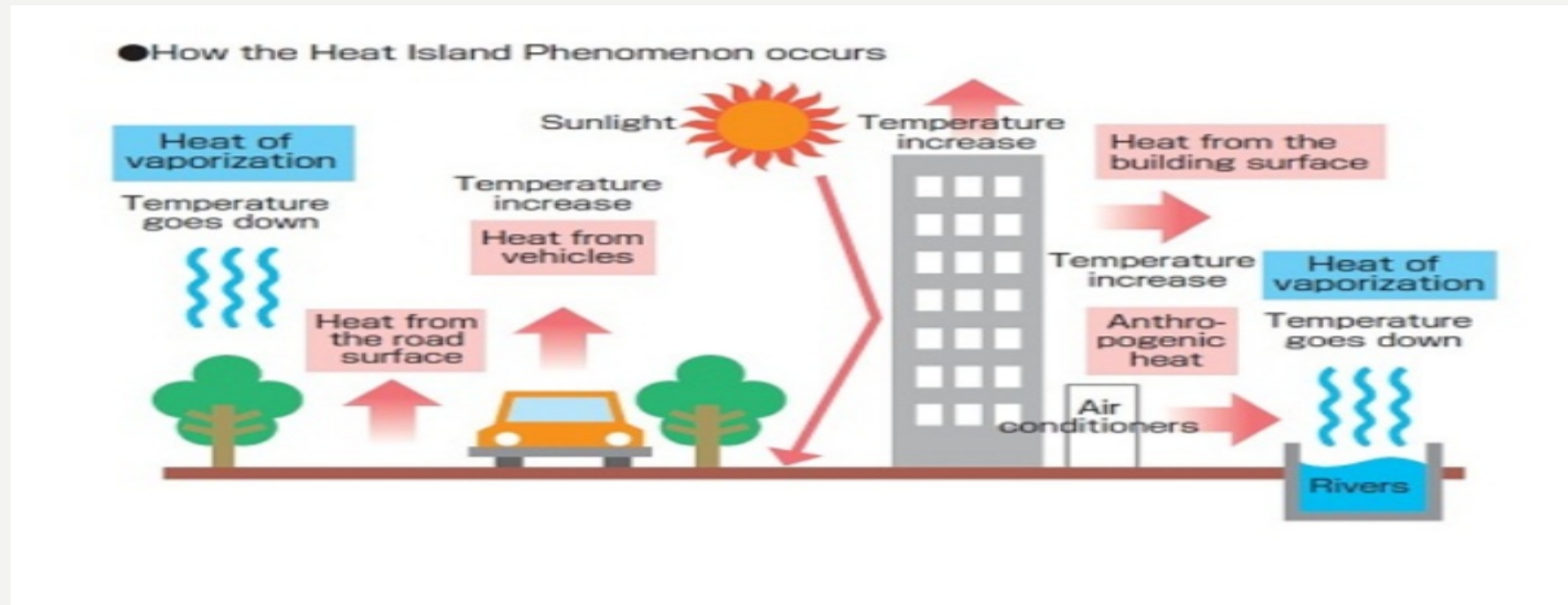
The temperature of water running over warm surfaces will increase, and this will also raise water temperature when it enters any body of water.



7.URBAN HEAT ISLANDS (UHIs)

An urban heat island (abbreviated as UHI) is where the temperature in a densely populated city is as much as 2 degrees higher than suburban or rural areas.

- UHIS can have worse water quality than their nearby rural area.
- UHIS also impact nearby water bodies, as warmer water is transferred from the city to drains in sewers, and released into nearby lakes and creeks, thus impairing their water quality.



EFFECTS OF THERMALPOLLUTION

[A] WARM WATER

1. Decreased Dissolved Oxygen:

- Elevated temperature typically decreases the level of **Dissolved Oxygen**, as gases are less soluble in warmer liquid. The decrease in DO can create suffocation for plants and animals such as fish, amphibians and copepods.
- High temperature limits oxygen dispersion into deeper waters, contributing to anaerobic condition. This can lead to increased bacteria levels when there is ample food supply.
- Warm water also increases the rate of decomposition of organic matter which is an oxygen consuming process thus contributing to depletion of dissolved oxygen.

2. Effect on Primary producers:

- Primary producers are affected by warm water because higher water temperature increases plant growth rates, resulting in a shorter lifespan and species overpopulation.
- The increased temperature can also change the balance of microbial growth, including the rate of algal blooms which reduce dissolved oxygen concentrations

3. Denaturing of life supporting enzymes:

- Most of the aquatic organisms have evolved in such a way that the enzyme systems are functional in a very narrow range of temperature and called stenothermic organisms. These stenothermic organisms can be killed by sudden temperature changes that are beyond the tolerance limits of their metabolic systems.
- A large increase in temperature can lead to the denaturing of life- supporting enzymes by breaking down hydrogen and disulphide bonds within the quaternary structure of the enzymes.
- Decreased enzyme activity in aquatic organisms can cause problems such as the inability to break down lipids, which leads to malnutrition.

4. Increase the solubility and kinetics of metals:

- Increased water temperature can also increase the solubility and kinetics of metals, which can increase the uptake of heavy metals by aquatic organisms.
- This can lead to toxic outcomes for these species, as well as build up of heavy metals in higher trophic levels in the food chain, increasing human exposures via dietary ingestion.

5. Effects on cell wall of aquatic animals:

- Principal adverse changes can include rendering cell walls less permeable to necessary osmosis, coagulation of cell proteins, and alteration of enzyme metabolism.
- These cellular level effects can adversely affect mortality and reproduction.

6. Effects on reproduction :

- Activities of fish life including nest building, hatching, spawning, reproduction and migration can also depend on water temperature. Changes in water temperature can affect the normal order and reproduction of species.
- Warmer water can reduce the fertility of some organisms.
- Other species may suffer birth defects or lay deformed eggs because of chemical changes in the body caused by warmer water.

6. Increase metabolic rate of aquatic animals:

- Thermal pollution may increase the metabolic rate of aquatic animals, as enzyme activity, resulting in these organisms consuming more food in a shorter time than if their environment were not changed.
- An increased metabolic rate may result in fewer resources; the more adapted organisms moving in may have an advantage over organisms that are not used to the warmer temperature.

7. Migration:

- The change in temperature may force species to migrate to another habitat creating a hollow food web.
- This can result in loss for those species that depend on them for their daily food as their food chain is interrupted.

8. Loss of Biodiversity:

- Many organisms are killed instantly by the hot water resulting into a high mortality. These changes to the environment can threaten or cause organism to migrate.
- Organisms which can easily adapt to changes in water will also have an advantage over others that may be more sensitive.

9.Increases level of toxins:

With the constant flow of warm water from industries, there is a huge increase in toxins that are being regurgitated into the natural body of water. These toxins may contain chemicals that may have harsh impact on the local ecology and may them susceptible to various diseases.

10.Thermal Shock:

When a power plant first opens or shuts down for repairment or other causes, fish and other organisms adapted to particular temperature range can be killed by the abrupt change in water temperature, either an increase or decrease, known as '**thermal shock**'.

Cold Water:

Release of unnaturally cold water from reservoirs can dramatically change the fish and macro-invertebrate fauna of rivers and can reduce river productivity.

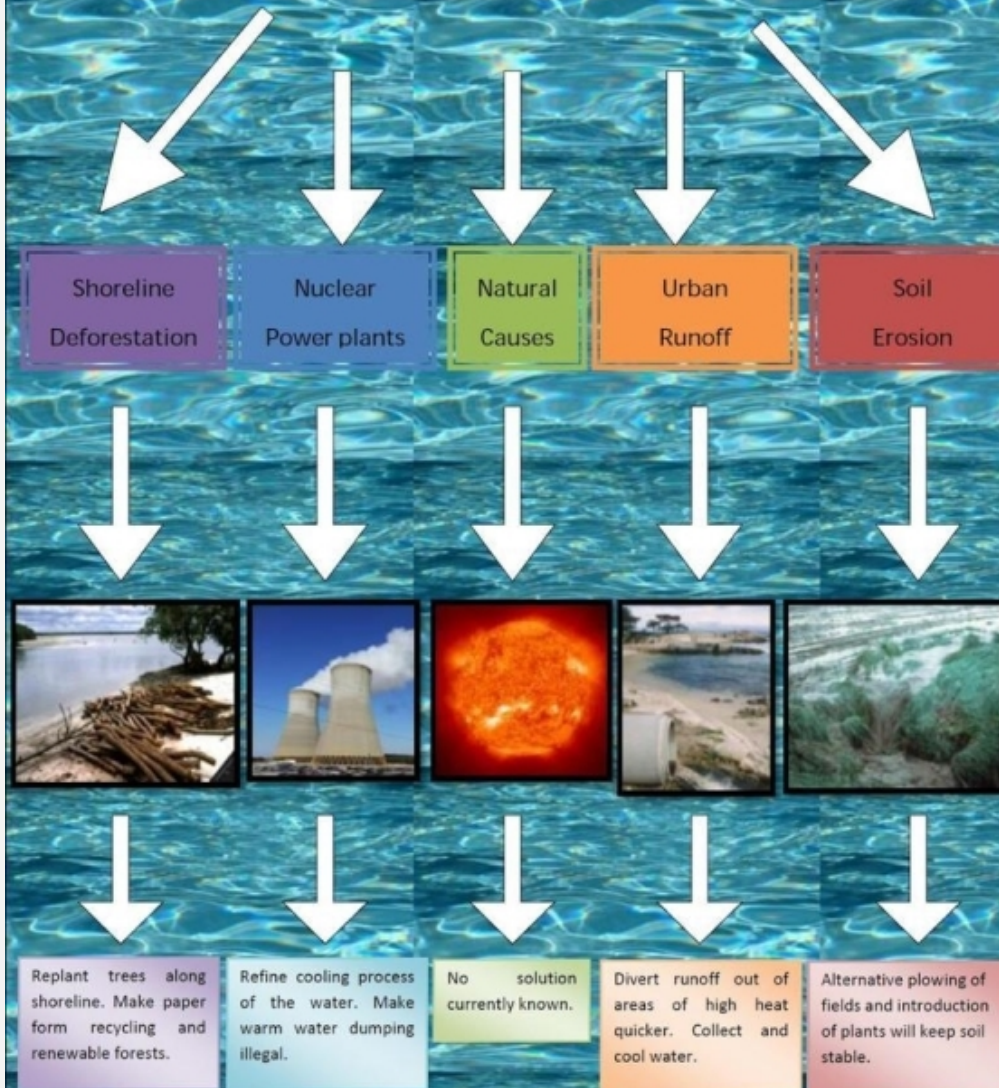
CONTROL OF THERMAL POLLUTION:

1. Cooling Ponds: It is one of the simplest and cheapest methods where the heated waste-water is stored in a pond before releasing it into the mainstream waterways. It gives enough time to dissipate the heat into the atmosphere through the process of evaporation.

2. Cooling Towers: These are installed in chemical processing power plants, steel mills, and other manufacturing processes where cooling of the effluent is required before discharge. It involves upward recirculation of a cascade of heated waste -water through the towers into the air by evaporative processes.

3. Role of Government: The role of government in controlling thermal pollution is very crucial in developing countries such as India concerning legal and abatement policy frameworks for wastewater treatment. This could be realized through stringent regulations and constant monitoring of effluent discharges from different industrial sectors.

Thermal Pollution Solution



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