CHAPTER 2

EFFECTS OF WASTES ON STREAMS

2.1 Effects on Streams

All industrial wastes affect, in some way, the normal life of a stream. When the effect is sufficient to render the stream unacceptable for its "best usage," it is said to be polluted. Best usage means just what the words imply: use of water for drinking, bathing, fishing, and so forth.

Streams can assimilate a certain quantity of waste before reaching a polluted state. Generally speaking, the larger, swifter, and more remote streams that are not much used are able to tolerate a considerable amount of waste, but too much of any type of polluting material causes a nuisance. To called a stream polluted, therefore, generally means that the stream contains an excessive amount of a specific pollutant or pollutants.

2.2 Type of Pollutants

The following materials can cause pollution:

Inorganic salts	Heated water
Acid and / or alkalis	Color
Organic matter	Toxic chemical
Suspended solids	Microorganisms

Floating solids and liquids.

(Nemerow 1971)

Inorganic salts When inorganic salts are present in industrial wastewaters, they cause the receiving water to become hard water and undesirable for industrial, minicipal and agricultural usage. These inorganic salts can deposit in pipelines and increase the flow resistance.

Inorganic salts, especially nitrogen and phosphorus, induce the growth of algae in surface waters. The disadvantage of algae is the organic loading they contribute after dying. Their advantage is that of adding dissolved oxygen to the stream.

The paper mills wastewater is nearly absence of nitrogen and phosphorus, which practically affect to algae life.

Acids and / or alkalis make a stream unsuitable not only for swimming, boating, but also for propagation of fish and other aquatic life. High concentrations of acid will lower the pH to below 7.0 . So the presence of acids or alkalis can be checked by pH value. The pH of a stream must not be less than 4.5 and not more than 9.5 if fish are to survive.

In general, the range of pH values of wastewaters allowable to be discharged into a stream is from 5 to 9 .

The pH values of most paper - mills wastewaters are usually from 6.5 to 7.9 which require no adjustment in discharging into the stream.

A low pH may cause corrosion to pipes and alkali in boiler - feed water can cause caustic embrittlement of pipe.

Organic matters exhaust the oxygen resources of rivers and create unpleasant tastes, odors, and general septic conditions. Fish and most aquatic life are stifled by the lack of oxygen; and the oxygen level, combined with other stream conditions, determines the life or death of fish. It is generally conceded that the critical range for fish survival is 3 to 4 parts per million (ppm) of dissolved oxygen. We know that some species of fish may not survive in water containing 3 ppm of dissolved oxygen, while other species may not be affected even slightly by the same low oxygen level. For example, trout are sensitive fish, requiring oxygen concentrations of at least 5 ppm, whereas carp are scavenger fish, capable of surviving in waters containing as little as 1 ppm of oxygen. This oxygen shortage, caused by organic matter, is often considered to be the most objectionable single factor in a stream pollution. Certain organic chemicals, such as phenols, affect the taste of domestic water supplies.

(Nemerow 1971)

In paper mills, wastewater also consists of some

organic matter such as rosin, fibres which must be treated to an allowable range before discharging to a stream.

Suspended solids settle to the bottom or wash up on the banks and decompose, causing odors and depleting oxygen in the river water. Fish often die because of a sudden lowering of the oxygen content of a stream, and solids that settle to the bottom will cover their spawning grounds and inhibit propagation. Visible sludge creates unsightly conditions and destroys the use of a river for recreational purposes. These solids also increase the turbidity of the water - course. (Memerow 1971)

There are high content of suspended solids in the paper mills wastewater which must be treated before discharging into a stream, only in amounts that will not impair the best usage of the stream.

Floating solids and liquids. These include oils, greases, and other materials which float on the surface; they not only make the river unsightly but also obstruct passage of light through the water, retarding the growth of vital plant food. Some specific objections to oil in streams are that is:
(1) interferes with natural reaeration; (2) is toxic to certain species of fish and aquatic life; (3) creates a fire hazard when present on the water surface in sufficient amounts; (4) destroys vegetation along the shoreline, with consequent erosion;
(5) renders boiler - feed and cooling water unusable;

(6) causes trouble in conventional water - treatment processes by imparting tastes and odors to water and coating sand filters with a tenacious film; (7) creates an unsightly film on the surface of the water; and (8) lowers recreational, e.g. boating, potential. (Nemerow 1971)

Heated water. An increase in water temperature, brought about by discharging wastes such as condenser waters into stream, has various adverse effects. Stream waters which vary in temperature from one hour to the next are difficult to process effectively in municipal and industrial water - treatment plants, and heated stream waters are of decreased value for industrial cooling. Indeed, one industry may so increase the temperature of a stream that a neighboring industry downstream cannot use the water. Furthermore, warm water is lighter than cold, so that stratification develops, and this causes most fish life to retreat to stream bottoms. Since there may be less dissolved oxygen in warm water than in cold, aquatic life suffers, and less oxygen is available for natural biological degradation of any organic pollution discharged into these warm surface waters. Also, bacterial action increases in higher temperatures, resulting in accelerated depletion of the stream's oxygen resources.

Color, contributed by textile and paper mills, tanneries, slaughterhouses and other industries, is an indicator of

pollution. Compounds present in wastewaters absorb certain wavelengths of light and reflect the remainder, a fact generally conceded to account for color development of streams. Color interferes with the transmission of sunlight into the stream and therefore lessens photosynthetic action. It may also interfere with oxygen absorption from the atmosphere - although no positive proof of this exists.

Visible pollution often causes more trouble for industry than invisible pollution. Unseen pollution which does not create a nuisance will often be tolerated by state agencies, but the red and deep - brown colors of slaughterhouse wastes, the browns of paper - mill wastes, various intense colors of textile mill wastes, and the yellows of plating - mill wastes will focus public indignation directly on those industries. It is only human to complain about visible pollution: property values decrease along a visibly polluted river, and fewer people will swim, boat, or fish in a stream highly colored by industrial wastes. Furthermore, municipal and industrial water plants have great difficulty, and scant success, in removing color from raw water. (Nemerow 1971)

Toxic Chemicals. Both inorganic and organic chemicals, even in extremely low concentrations, may be poisonous to fresh - water fish and other, smaller, aquatic microorganisms. Many of these compounds are not removed by municipal treatment plants and have a cumulative effect on biological systems.

Such insecticides as toxaphene, dieldrin, and dichlorobenzene have allegedly killed fish in farm ponds and streams. Insecticides used in cotton and tobacco dusting have their maximum effect following heavy rainfalls - i.e. they are more lethal in solution - but insecticides and redenticides are hard to detect in a stream. However, newer techniques, e.g. electron - capture gas chromatography, can detect chlorinated hydrocarbon pesticides in concentrations of 0.001 micrograms per liter in one - liter samples of water.

New, highly complex, organic compounds produced by the chemical industry for textile and other companies have also proved extremely toxic to fish life. One example is acrylonitrile, a raw material used in the manufacture of certain new synthetic fibers.

Almost all salts, some even in low concentrations, are toxic to certain forms of aquatic life. Thus chlorides are reportedly toxic to fresh - water fish in 400 ppm concentration, as are hexavalent chromium compounds in concentrations of 5 ppm. Copper concentrations as low as 0.1 to 0.5 ppm are toxic to bacteria and other microorganisms. Although oyster larvae, for setting require a copper concentration of about 0.05 to 0.06 ppm, concentrations above 0.1 to 0.5 ppm are toxic to some species. All three salts are often found in watercourses.

Accidental or intermittent discharge of certain toxic materials may go unnoticed and yet may completely disrupt stream life. Building - floor and storm - water drains that lead directly to the stream may convey contamination because of an upset in an industrial process or ignorance of the consequences. For example, the flushing of a chemical delivery tank at the unloading dock may carry dissolved toxic material into the stream through a storm drain.

Complex inorganic phosphates, such as P_2O_5, at levels as low as 0.5 ppm, perceptibly interfere with normal coagulation and sedimentation processes in water - purification plants. Increased coagulant dosages and / or increased settling times are required to solve the problem. Phenols in concentrations exceeding one part per billion have been found to be objectionable in a stream. Phenol reacts with chlorine and, even in extremely small quantities, gives the residual drinking water a noticeable medicinal taste. (Nemerow 1971)

Microorganisms. A few industries, such as tanneries and slaughterhouses, sometimes discharge wastes containing bacteria. Vegetable and fruit canneries may also add bacterial contamination to streams. These bacteria are of two significant types :
(a) Bacteria which assist in the degradation of the organic matter as the waste moves downstream. This process may aid in "Seeding" a stream (deliberate inoculation with biological life for the purpose of degrading organic matter) and in accelerating

the occurrence of oxygen sag in the water. (b) Bacteria which are pathogenic, not only to other bacteria, but also to humans. An example is the anthrax bacillus, originating in tanneries where hides from - anthrax - infected animals have been processed.

(Nemerow 1971)
