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Natural Purification Capacity of Rivers

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ABSTRACT : *The natural purification of streams is a very important phenomena for the cleanliness of the river and associated environment. The most critical parameter on which the pollution af the water body is based is the dissolved oxygen in the water which is the effect of BOD- The delicate balance is maintained between the dissolved oxygen of water and the sources and the sinks of dissolved oxygen. The present paper gives an account of natural purificatirn capacity of rivers. A concise account of the various studies in this regard in the major rivers of the country have been presented. The various sources and sinks of dissolved oxygen and the BOD have been ennumerated and it has been advocated that the self purifying abilities of the streams should be properly evaluated and exploited to the fullest so that the pollution control cost could be minimised. The example of river Ganga and river Yamuna have been cited.*

1. Introduction

The nature takes care of the polluted streams, but its a slow process which explains why the streams remain polluted for long distances (times). However, the natural purification effectively takes place in respect of the non-conservative parameters such as the BOD, microbes, settleable impurities. etc., which can decay or get removed in the natural course of time. Fortunately these are the serious parameters that show a stream polluted and render it unfit for many of the beneficial uses. In situations, where the conservative parameters (which do not decay with time, such as the many chemical dissolved constituents) are let into the rivers, its the dilution of the stream as well as the underground water infiltration into the rivers that takes care of them by diluting their concentrations to levels that may be acceptable or remain at undetectable concentrations (Bhargava, 1983 b, f; 1984 a, d; 1985 b, e, f).

The settleable soilds contained by a polluted river would settle out and this depends on the nature of the settleables as well as the velocity of the stream (Bhargava, 1983 a). That is the reason why the slow moving polluted rivers (for example, the Yamuna river in comparison to the Ganga river) appear relatively clearer (Bhargava, 1981 b; 1984 a, d; 1985 e, f; 1987 b). The wastewaters entering into the rivers contribute a significant settleable pollution load. The magnitude of such loads depends on the degree of treatment received by the waste waters before their release into the streams (Bhargava, 1981 a; 1982 a; 1983 c, d; 1986 a, c, e; 1987 c). The settleable material thus removed in the rivers also removes a significant portion of the BOD which may be present in a settleable and colloidal forms (Bhargava, 1981 a; 1982 a; 1983 c, d; 1986 b, c). Bioflocculation naturally takes place in the polluted streams (Bhargava, 1981 a; 1982 a; 1983 c, d; 1986 b, c) and provide the necessary G (mean velocity gradient) values to result in bioflocculation (Bhargava, 1983 c) and a consequent removal of the colloidal BOD.

The microbes naturally die out in the natural environment of the streams. The microbes that thrive in the human system, can not find a similar favouring conditions in the streams for survival. Some microbes however, survive for longer durations than the others. This naturally devoids the streams to a great extent of the potentially dangerous microbes in the course of time (Bhargava, 1981 a; 1983 d; 1984d;1985 c, e, f; 1986 c; 1987 b).

BOD, the significant pollutional parameter of streams is naturally decayed in a stream system through a biochemical oxidation whose kinetic rates would control the rate of BOD removal from the streams. Earlier, Streeter-Phelps (1925) had worked out such kinetic rate constants for BOD removal in the Ohio rivers and had reported such values of the order of about 0.23 to the base e. Their models as well as the models of several other researchers (Velz & Gannon, 1962) did not (at all or appropriately) account for the sedimentation effect that removes a significant portion of the stream BOD. The author's extensive studies (Bhargava, 1981 a, b; 1982a, b, c, d; 1983 a, b, c, d, e, f, g; 1984 a, b, c, d; 1985 a, b, c, d, e, f; 1986 a, b, c, d, e; 1987 a, b, c; Maheshwari & Bhargava, 1984; Tirath & Bhargava, 1983) on the Ganga-Yamuna rivers have accounted for the BOD removals through both, the sedimentation (straight line removal) and exponential decay (Bhargava, 1982 b; 1983 c; 1986 a, b, c; 1987 c). The BOD rate constant for the exponential decay was higher by an order of magnitude (Ganga had much higher value than the Yamuna). These factors, together with a higher reaeration rate in these rivers result in an extremely fast self-purifieation of the Ganga-Yamuna rivers (Bhargava, 1981 a; 1983 c; 1985 e, f; 1986 a, b, c, d; 1987 b). A very comprehensive account for these phenomenon, the bulk of data, an analysis of the BOD phenomenon that takes place in the rivers, development of the DO sag models in the rivers under the varying discharge conditions have been presented elsewhere (Bhargava, 1983 c; 1916 a, b, c, d). In real pollution control methodologies and technologies, this self-purifying abilities of the streams should be properly evaluated, and exploited to the fullest extent so that the pollution control cost may be minimized (Bhargava, 1981 b; 1982 b, c, d; 1983 e, f; 1984 b, c; 1985 d, f; 1986 c, e; 1987 a, b. c; Maheshwari & Bhargava. 1984; Tirath & Bhargava, 1983).

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