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Water Quality modelling of Kali River using Quale2E

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ABSTRACT

River/Stream, whether or not its water is used for different beneficial purposes , plays a significant role in shaping the socio-economic, socio-cultural, over and above, environmental and ecological balances of a region through which it is routed. Despite of all these versatile contributory roles, knowingly or unknowingly, river/stream, in many areas, are being used as a dumping spot of disposal of municipal and industrial wastewaters with the intention that river/stream will take care of these wastes. Water bodies have some limiting cleansing capacity of wastes- a known fact- excessive discharge of effluent beyond the self purification capacity of water bodies would definitely pollute the water. If the situation continues for long time, a fresh water stream may even transform to a sewer or in other words, a water surplus region may transform to a water scarce region.

The study of river kali reported here is an unique example of transformation of a fresh water stream (as it is seen before the mixing of wastewaters) to a sewer by the direct disposal of municipal, industrial and sugar mills wastewaters originating from Muzaffarnagar city and adjoing areas.

Attempts have been made in this study to address the following aspects :

i) present state of pollution over stretches downstream of effluent discharges, and modelling of some water quality parameters using QUAL2E,
ii) determination of assimilative capacity of the river with reference to BOD,
iii) flow augmentation required to arrest the water quality within prescribed limits designated for different uses,and,
iv) determination of suitable WLA (Waste Load Allocation),as an alternative to flow augmentation, to maintain the self purification capacity of the river,

Within the study stretch of 65 Km. starting from Malira bridge (about 10 Km. upstream of Muzzafarnagar city) upto the confluence with Hindon river (stretch affected by the human activities) wastewaters quality of 4 point sources originated from the

municipal, industrial and sugar mills, and river water quality of 15 different locations have been monitored and modelled to get the indicative of 8 water quality constituents. Out of the river flows of about 7.25 m3/sec (dry weather flow), 1.37 m3/sec (19 % of river flow) is contributed by 4 outfalls in which two municipal drains contain respectively; 0. 30 m3/sec and 0.36 m3/sec while industrial and sugar mills drain share 0.554m3/sec and 0.166 m3/sec respectively. The pollution load interms of BOD as measured for all these 4 outfalls respectively are :325 mg/1, 328 mg/1, 801 mg/1 and 1695 mg/l.

Computation of concentration profiles using QUAL2E shows a good match between the observed and computed values. Two distinct DO sags; one is between the municipal drain and industrial drain at river Km. 45 (from confluence) with critical DO value of 1.74 mg/1, another is downstream of industrial and sugar mills drains for a stretch of 20.0 Km. within river Km.32 to 12.00 (from confluence) with critical DO value of "0", are obtained.

In order to overcome the critical stage of DO deficit, attempt has also been made to assess the flow augmentation required (considering Headwaters is the source) and the tolerance limit of waste load application i.e., control of pollution at source, as two alternatives. It is observed that 4.21 times (15.5m3/sec) of headwaters flow (11.82 m,3/sec additional flow) is required to increase the DO level from 1.74 mg/l to 5.0 mg/l for the first DO sag, while in case of second DO sag i.e., after sugar mills drain, 19.1 times (70.26 m3/sec) of headwaters flow (66.58 m3/sec additional flow) is required to increase the DO level from "0" to 5 mg/l. For waste load allocations, in order to get back the river DO level at 5 mg/l, about 80% of effluent BOD for municipal wastewaters and 85% effluent BOD of industrial and sugar mills wastewaters are to be removed before being discharged to the river. Waste Load Allocation seems to be the better option than the flow augmentation (as there is no source of augmentation of flow) in order to maintain the self purification capacity and also the health of the river. The report also contains the simulated profiles of Nitrogen cycle, Phosphorous cycle, TDS, and pH.

Results reported in this study are based on limited data sets collected by ourselves thus reflect an indicative of pollution status of the river and is an attempt towards application of QUAL2E to see its effectiveness of the model. Details study based on continuous monitoring is, therefore, recommended to check the effectiveness of findings.