4.3 Radio-active Tracer Technique for Measurement of River Discharges

The conventional method of measurement of discharge in open channels by adopting area velocity method necessitates measurement of river cross-section at a site and also observing velocities on several verticals across the measuring section. But this procedure may not be feasible in all the cases. The radio-active tracer method (total count) dispenses with the measurement of cross section and velocities and, where, it is applicable, is much simpler, cheaper and quicker. These methods have been tested for measurement of discharge up to 227 m^3s^{-1}, and accuracy as high as 98 percent is attained. Central Water Power Research Station, Pune in collaboration with Bhabha Atomic Research Centre, Bombay conducted experiments using (i) radio-active tracer technique on River Mutha, in the recirculation system of the CWPRS and in River Tapi and

(ii) Chemical Salt dilution method downstream of tail-race tunnel of Koyna Power House and in Vaitarni River. The measurement of discharge by these methods require pre-knowledge of mixing length. The mixing length is defined as the minimum distance at which the mass transfer and the concentration are equal, i.e.,

$$\frac{d_c}{c} = \frac{d_m}{m}$$

The mixing length depends upon many factors such as: (i) degree of turbulence, (ii) geometry of the cross-section, (iii) number and position of tracer injection, (iv) properties of tracer used, and (v) velocity distribution.

CWPRS, Pune by using the radio isotope method found that in case of Tapi River the mixing length is 40.23 km for a river discharge of 756 m^3s^{-1}. Further it was also observed that mixing length is higher in case of side injection compared to the central injection of the tracer.

Uttar Pradesh Irrigation Research Institute, Roorkee conducted experiments in mountainous rivers of Himalayan origin. The data obtained from these experiments showed that the mixing length (l_{mix}) in mountainous rivers varies linearly with the

average river width B_o in the experimental reach and is governed by the relation

$$l_{mix} = KB_o + C$$

in which, K and C are constants and found to be 77 and 120 respectively in a set of experiments given in Table. The flow rate obtained by dilution method compared well with that obtained by area velocity method.

Name of the River	Discharge m^3s^{-1}		River slope (m/km)	Average top water surface depth (m)	Observed mixing length (km)	Remarks
Ganga	as per area velocity method (m^3s^{-1})	as per dilution method (m^3s^{-1})				
Ganga	296.00	319.00	1.21	70.00	4.30	
Ganga	136.00	-	1.21	57.00	-	Power mixing was not achieved
Ganga	150.50	147.10	1.21	55.00	4.00	
Song	148.50	154.20	4.48	50.00	3.40	
Tons	14.00	13.70	5.59	20.00	1.11	
Ganga	425.00	453.25	2.00	52.00	4.53	
Ganga	771.70	763.00	3.16	136.00	10.10	
Song	629.60	640.60	3.16	104.00	9.00	
	6.20	6.90	7.30	23.20	1.60	