

WATER QUALITY MODELING or RESIDUAL CHLORINE MODEL USING EPANET

Title: Spatio -Temporal Assessment of Chlorine Residual in the Specific Water Distribution System of Dhaka City

The objective of any water distribution system is to make water available to the consumer in proper quantity and pressure, with acceptable quality in terms of pH, odor and sanitary security. Now-a-days, proper understanding, characterization and prediction of water quality behavior in the drinking water distribution system are critical to ensure meeting regulatory requirements and customer-oriented expectations. Preserving the water quality throughout the distribution system is, therefore, one of the most challenging technological issues for suppliers.

Dhaka Water Supply and Sewerage Authority (DWASA) have divided the Dhaka City into approximately 100 District Metered Areas (DMAs) to improve the water supply network of Dhaka City (<http://archive.thedailystar.net/newdesign/news-details>).

Although, there is a protocol for chlorination at the pump stations as well as a schedule for monitoring of residual chlorine, the adoption of these protocols has been found to be absent in most DMAs. Often chlorine is administered rather arbitrarily and its effectiveness in the water distribution system remains largely unknown. Even, the concentration of residual chlorine within a water distribution network may vary in accordance with the variation of location and time.

Therefore, there is need for a water a water quality (residual chlorine) model which may be used as a necessary tool to predict the spatial and temporal variations of residual chlorine concentration throughout the water distribution network. So, a predictive tool can be used to assess the effectiveness of chlorination system spatially and temporally within a very short time in DWASA water supply system. We can also use this tool in the other Municipality areas as well as City Corporation in Bangladesh as a climate resilience adaptation tool for supplying safe drinking water.

An indicative water supply distribution network is presented below.

To develop and validate the water quality model spatial and temporal data were collected at the consumer end as well as at DMA. The data were collected at an interval of one hour and about 100m node interval.

The presented results are average of residual chlorine level for sample taken at 7:00 AM and 03:00 PM

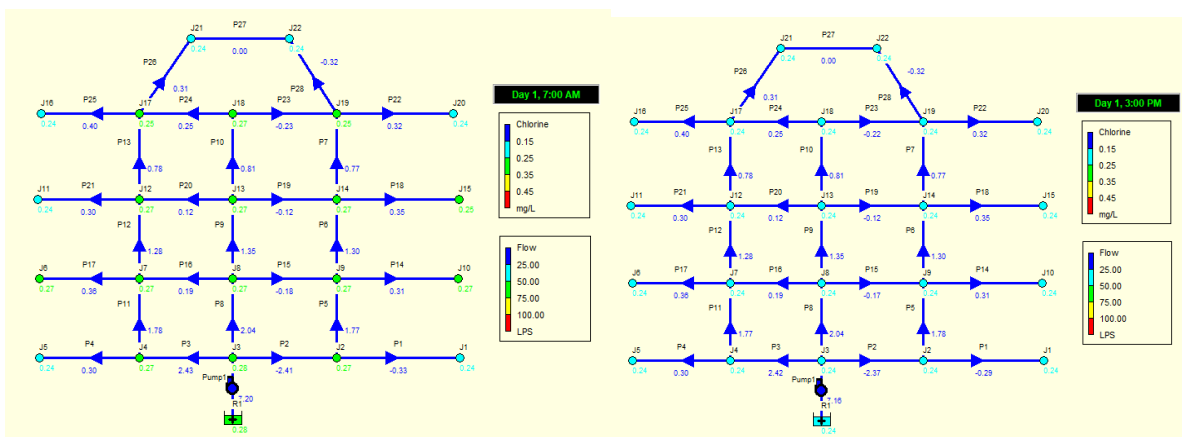


Figure 1: Residual chlorine concentration with respect to flow (left) for 7:00 AM; (right) for 3:00 PM

Table 1: Nodes Details of Network for 7:00 AM

Node ID	Base Demand	Demand	Head	Pressure	Chlorine
	LPS	LPS	m	m	mg/L
J1	0.30	0.33	18.79	8.79	0.24
J2	0.31	0.31	18.79	8.59	0.27
J3	0.32	0.32	18.80	8.70	0.28
J4	0.35	0.35	18.79	8.49	0.27
J5	0.30	0.30	18.78	8.78	0.24
J6	0.36	0.36	18.74	8.24	0.27
J7	0.32	0.32	18.75	8.45	0.27
J8	0.33	0.33	18.75	8.35	0.27
J9	0.34	0.34	18.75	8.75	0.27
J10	0.31	0.31	18.74	8.64	0.27
J11	0.30	0.30	18.72	8.52	0.24
J12	0.32	0.32	18.73	8.43	0.27
J13	0.30	0.30	18.73	8.53	0.27
J14	0.30	0.30	18.73	8.48	0.27
J15	0.35	0.35	18.72	8.42	0.25
J16	0.40	0.40	18.72	8.32	0.24
J17	0.32	0.32	18.72	8.22	0.25
J18	0.34	0.34	18.72	8.42	0.27
J19	0.35	0.35	18.72	8.32	0.25
J20	0.32	0.32	18.72	8.60	0.24
J21	0.31	0.31	18.72	8.57	0.24
J22	0.32	0.32	18.72	8.42	0.24
Resvr R1	#N/A	-7.20	5.00	0.00	0.28

Table 2: Nodes Details of Network for 3:00 PM

Node ID	Base Demand	Demand	Head	Pressure	Chlorine
	LPS	LPS	m	m	mg/L
J1	0.3	0.29	18.83	8.83	0.24
J2	0.31	0.31	18.83	8.63	0.24
J3	0.32	0.32	18.84	8.74	0.24
J4	0.35	0.35	18.83	8.53	0.24
J5	0.3	0.3	18.83	8.83	0.24
J6	0.36	0.36	18.78	8.28	0.24
J7	0.32	0.32	18.79	8.49	0.24
J8	0.33	0.33	18.79	8.39	0.24

J9	0.34	0.34	18.79	8.79	0.24
J10	0.31	0.31	18.78	8.68	0.24
J11	0.3	0.3	18.76	8.56	0.24
J12	0.32	0.32	18.77	8.47	0.24
J13	0.3	0.3	18.77	8.57	0.24
J14	0.3	0.3	18.77	8.52	0.24
J15	0.35	0.35	18.76	8.46	0.24
J16	0.4	0.4	18.76	8.36	0.24
J17	0.32	0.32	18.76	8.26	0.24
J18	0.34	0.34	18.76	8.46	0.24
J19	0.35	0.35	18.76	8.36	0.24
J20	0.32	0.32	18.76	8.64	0.24
J21	0.31	0.31	18.76	8.61	0.24
J22	0.32	0.32	18.76	8.46	0.24
Resvr R1	#N/A	-7.16	5	0	0.24

Table 3 Pipes Details of Network for 7:00 AM

Link ID	Length m	Diameter mm	Roughness	Bulk Coeff. /s	Wall Coeff. m/s	Flow LPS	Velocity m/s	Unit Headloss m/km	Friction Factor	Reaction Rate mg/L/d	Chlorine mg/L	Status
P1	100	150	150	- 0.0049	- 0.002	- 0.33	0.02	0	0.031	0.01	0.26	Open
P2	100	150	150	- 0.0049	- 0.002	- 2.41	0.14	0.15	0.023	0.02	0.27	Open
P3	100	150	150	- 0.0049	- 0.002	- 2.43	0.14	0.15	0.023	0.02	0.27	Open
P4	100	150	150	- 0.0049	- 0.002	- 0.3	0.02	0	0.031	0.01	0.26	Open
P5	100	110	150	- 0.0049	- 0.002	- 1.77	0.19	0.37	0.023	0.02	0.27	Open
P6	100	110	150	- 0.0049	- 0.002	- 1.3	0.14	0.21	0.024	0.02	0.27	Open
P7	100	110	150	- 0.0049	- 0.002	- 0.77	0.08	0.08	0.026	0.02	0.27	Open
P8	100	110	150	- 0.0049	- 0.002	- 2.04	0.21	0.48	0.023	0.02	0.27	Open
P9	100	110	150	- 0.0049	- 0.002	- 1.35	0.14	0.23	0.024	0.02	0.27	Open
P10	100	110	150	- 0.0049	- 0.002	- 0.81	0.09	0.09	0.026	0.02	0.27	Open
P11	100	110	150	- 0.0049	- 0.002	- 1.78	0.19	0.37	0.023	0.02	0.27	Open
P12	100	110	150	- 0.0049	- 0.002	- 1.28	0.13	0.2	0.024	0.02	0.27	Open
P13	100	110	150	- 0.0049	- 0.002	- 0.78	0.08	0.08	0.026	0.02	0.27	Open
P14	100	75	150	- 0.0049	- 0.002	- 0.31	0.07	0.1	0.029	0.03	0.27	Open
P15	100	75	150	- 0.0049	- 0.002	- 0.18	0.04	0.03	0.031	0.03	0.27	Open

P16	100	75	150	- 0.0049	- 0.002	0.19	0.04	0.04	0.031	0.03	0.27	Open
P17	100	75	150	- 0.0049	- 0.002	0.36	0.08	0.13	0.028	0.03	0.27	Open
P18	100	75	150	- 0.0049	- 0.002	0.35	0.08	0.12	0.028	0.03	0.27	Open
P19	100	75	150	- 0.0049	- 0.002	- 0.12	0.03	0.02	0.033	0.03	0.26	Open
P20	100	75	150	- 0.0049	- 0.002	0.12	0.03	0.02	0.033	0.03	0.26	Open
P21	100	75	150	- 0.0049	- 0.002	0.3	0.07	0.09	0.029	0.03	0.27	Open
P22	100	110	150	- 0.0049	- 0.002	0.32	0.03	0.02	0.03	0.02	0.24	Open
P23	100	110	150	- 0.0049	- 0.002	- 0.23	0.02	0.01	0.031	0.02	0.25	Open
P24	100	110	150	- 0.0049	- 0.002	0.25	0.03	0.01	0.031	0.02	0.25	Open
P25	100	110	150	- 0.0049	- 0.002	0.4	0.04	0.02	0.029	0.02	0.24	Open
P26	100	110	150	- 0.0049	- 0.002	0.31	0.03	0.01	0.03	0.02	0.24	Open
P27	100	110	150	- 0.0049	- 0.002	0	0	0	0	0	0.02	Open
P28	100	110	150	- 0.0049	- 0.002	- 0.32	0.03	0.02	0.03	0.02	0.24	Open
Pump Pump1	#N/A	#N/A	#N/A	#N/A	#N/A	7.2	0	-13.8	0	0	0.28	Open

Table 4: Pipes Details of Network for 3:00 PM

Link ID	Length m	Diameter mm	Roughness	Bulk Coeff. /s	Wall Coeff. m/s	Flow LPS	Velocity m/s	Unit Head loss m/km	Friction Factor	Reaction Rate mg/L/d	Chlorine mg/L	Status
P1	100	150	150	-0.0049	-0.002	- 0.29	0.02	0.00	0.03	0.01	0.24	Open
P2	100	150	150	-0.0049	-0.002	- 2.37	0.13	0.14	0.02	0.01	0.24	Open
P3	100	150	150	-0.0049	-0.002	2.42	0.14	0.15	0.02	0.01	0.24	Open
P4	100	150	150	-0.0049	-0.002	0.30	0.02	0.00	0.03	0.01	0.24	Open
P5	100	110	150	-0.0049	-0.002	1.78	0.19	0.37	0.02	0.02	0.24	Open
P6	100	110	150	-0.0049	-0.002	1.30	0.14	0.21	0.02	0.02	0.24	Open
P7	100	110	150	-0.0049	-0.002	0.77	0.08	0.08	0.03	0.02	0.24	Open
P8	100	110	150	-0.0049	-0.002	2.04	0.21	0.48	0.02	0.02	0.24	Open
P9	100	110	150	-0.0049	-0.002	1.35	0.14	0.23	0.02	0.02	0.24	Open
P10	100	110	150	-0.0049	-0.002	0.81	0.09	0.09	0.03	0.02	0.24	Open
P11	100	110	150	-0.0049	-0.002	1.77	0.19	0.37	0.02	0.02	0.24	Open
P12	100	110	150	-0.0049	-0.002	1.28	0.13	0.20	0.02	0.02	0.24	Open
P13	100	110	150	-0.0049	-0.002	0.78	0.08	0.08	0.03	0.02	0.24	Open
P14	100	75	150	-0.0049	-0.002	0.31	0.07	0.10	0.03	0.03	0.24	Open

P15	100	75	150	-0.0049	-0.002	-0.17	0.04	0.03	0.03	0.03	0.24	Open
P16	100	75	150	-0.0049	-0.002	0.19	0.04	0.04	0.03	0.03	0.24	Open
P17	100	75	150	-0.0049	-0.002	0.36	0.08	0.13	0.03	0.03	0.24	Open
P18	100	75	150	-0.0049	-0.002	0.35	0.08	0.12	0.03	0.03	0.24	Open
P19	100	75	150	-0.0049	-0.002	-0.12	0.03	0.02	0.03	0.02	0.24	Open
P20	100	75	150	-0.0049	-0.002	0.12	0.03	0.02	0.03	0.02	0.24	Open
P21	100	75	150	-0.0049	-0.002	0.30	0.07	0.09	0.03	0.03	0.24	Open
P22	100	110	150	-0.0049	-0.002	0.32	0.03	0.02	0.03	0.02	0.24	Open
P23	100	110	150	-0.0049	-0.002	-0.22	0.02	0.01	0.03	0.02	0.24	Open
P24	100	110	150	-0.0049	-0.002	0.25	0.03	0.01	0.03	0.02	0.24	Open
P25	100	110	150	-0.0049	-0.002	0.40	0.04	0.02	0.03	0.02	0.24	Open
P26	100	110	150	-0.0049	-0.002	0.31	0.03	0.01	0.03	0.02	0.24	Open
P27	100	110	150	-0.0049	-0.002	0.00	0.00	0.00	0.17	0.00	0.04	Open
P28	100	110	150	-0.0049	-0.002	-0.32	0.03	0.02	0.03	0.02	0.24	Open
Pump1	#N/A	#N/A	#N/A	#N/A	#N/A	7.16	0.00	-13.84	0.00	0.00	0.24	Open