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RIVER WATER QUALITY MONITORING USING STATISTICAL PROCESS CONTROL IN DUNGUN RIVER BASIN, TERENGGANU, MALAYSIA

(Pemantauan Kualiti Air Sungai Menggunakan Kawalan Proses Berstatistik di Lembangan Sungai Dungun, Terengganu, Malaysia)

TENGKU NURUL AIMI BALQIS TENGKU MALIM BUSU* & NOR AISHAH AHAD

ABSTRACT

Water pollution keeps rising due to the industrialisation and urbanisation in Malaysia. This matter needs to be given serious attention to avoid further contamination of the river water. Therefore, the quality of river water should be measured to avoid water pollution. This study was carried out to determine river water quality whether the water is safe for aquatic life or not at Dungun River Basin, Terengganu, based on the chemical parameters, which are the pH value and the Total Dissolved Solids (TDS). The water sampling was conducted at three separate sites along the river, and the distance between each station is approximately 2 km. Box plot, scatter plot, and control chart are being used in the analysis. The box plot results show that the water pH value and TDS level are normally distributed with no outliers. The scatter plot shows that the pH value and TDS level have a weak positive relationship with the correlation value of 0.4063. The control chart shows the pH value and TDS level are stable and within control. However, apart from the physical, chemical, and microbiological parameters, water quality must be accessed to ensure a high quality of drinking water. Based on the National Water Quality Standard (NWQS), the result shows that pH was classified as Class IV, while TDS was classified as Class IIA. Therefore, the river water required conventional treatment, but it still can be used for irrigation.

Keywords: river water quality; statistical process control; control chart

ABSTRAK

Pencemaran sungai terus meningkat disebabkan oleh perindustrian dan pembandaran di Malaysia. Perkara ini perlu diberi perhatian serius untuk mengelakkan berlakunya pencemaran air sungai. Oleh itu, kualiti air sungai harus diukur untuk mengelakkan pencemaran air. Kajian ini dilakukan untuk mengetahui kualiti air sungai sama ada airnya selamat untuk hidupan air atau tidak di Lembangan Sungai Dungun, Terengganu, berdasarkan parameter kimia, iaitu nilai pH dan jumlah pepejal terlarut (JPT). Pensampelan air dilakukan di tiga lokasi terpisah di sepanjang sungai dan jarak antara setiap stesen adalah sekitar 2 km. Plot kotak, plot serakan, dan carta kawalan digunakan dalam analisis. Hasil plot kotak menunjukkan bahawa nilai pH air dan tahap JPT adalah tertabur normal dengan tanpa data pencilan. Plot serakan menunjukkan nilai pH dan tahap JPT mempunyai hubungan positif yang lemah dengan nilai korelasi 0.4063. Carta kawalan menunjukkan nilai pH dan tahap JPT stabil dan terkawal. Namun, selain dari parameter fizikal, kimia, dan mikrobiologi, kualiti air mesti dicapai untuk memastikan air minuman berkualiti tinggi. Berdasarkan Piawaian Kualiti Air Kebangsaan (PKAK), hasil menunjukkan bahawa pH dikelaskan sebagai Kelas IV, sementara JPT dikelaskan sebagai Kelas IIA. Oleh itu, air sungai ini memerlukan rawatan konvensional tetapi masih dapat digunakan untuk pengairan.

Kata kunci: kualiti air sungai; kawalan proses berstatistik; carta kawalan

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School of Quantitative Sciences
College of Arts and Sciences
Universiti Utara Malaysia
06010 Sintok
Kedah DA, MALAYSIA
E-mail: tengkuaimi98@gmail.com, aishah@uum.edu.my*

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*Corresponding author

Appendix. Table of Control Chart Constants (Joglekar A.M. 2003)

				$\bar{X}$ and R Charts			$\bar{X}$ and S Charts		
n	d_2	d_3	C_4	A_2	D_3	D_4	A_3	B_3	B_4
2	1.128	0.8525	0.7979	1.880	—	3.267	2.659	—	3.267
3	1.693	0.8884	0.8862	1.023	—	2.574	1.954	—	2.568
4	2.059	0.8798	0.9213	0.729	—	2.282	1.628	—	2.266
5	2.326	0.8798	0.9400	0.577	—	2.114	1.427	—	2.089
6	2.534	0.8480	0.9515	0.483	—	2.004	1.287	0.030	1.970
7	2.704	0.8332	0.9594	0.419	0.076	1.924	1.182	0.118	1.882
8	2.847	0.8198	0.9650	0.373	0.136	1.864	1.099	0.185	1.815
9	2.970	0.8078	0.9693	0.337	0.184	1.816	1.032	0.239	1.761
10	3.078	0.7971	0.9727	0.308	0.223	1.777	0.975	0.284	1.716
11	3.173	0.7873	0.9754	0.285	0.256	1.744	0.927	0.321	1.679
12	3.258	0.7785	0.9776	0.266	0.283	1.717	0.886	0.354	1.646
13	3.336	0.7704	0.9794	0.249	0.307	1.693	0.850	0.382	1.618
14	3.407	0.7630	0.9810	0.235	0.328	1.672	0.817	0.406	1.594
15	3.472	0.7562	0.9823	0.223	0.347	1.653	0.789	0.428	1.572
16	3.532	0.7499	0.9835	0.212	0.363	1.637	0.763	0.448	1.552
17	3.588	0.7441	0.9845	0.203	0.378	1.662	0.739	0.466	1.534
18	3.640	0.7386	0.9854	0.194	0.391	1.607	0.718	0.482	1.518
19	3.689	0.7335	0.9862	0.187	0.403	1.597	0.698	0.497	1.503
20	3.735	0.7287	0.9869	0.180	0.415	1.585	0.680	0.510	1.490
21	3.778	0.7272	0.9876	0.173	0.425	1.575	0.663	0.523	1.477
22	3.819	0.7199	0.9882	0.167	0.434	1.566	0.647	0.534	1.466
23	3.858	0.1759	0.9887	0.162	0.443	1.557	0.633	0.545	1.455
24	3.895	0.7121	0.9892	0.157	0.451	1.548	0.619	0.555	1.445
25	3.931	0.7084	0.9896	0.153	0.459	1.541	0.606	0.565	1.435