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Water self-purification processes in mond river (mond protected area, Iran)

Tirdad Maghsoudloo [1*], Abdol R. Pazira [1], Saeid Moghdani [2], Farshad Ghanbari [2]

[1]*Department of Engineering, College of Natural Resources, Islamic Azad University, Bushehr Branch, Iran*

[2.]*Young Researchers and Elite Club, Bushehr Branch, Islamic Azad University, Bushehr, Iran*

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Abstract

In order to this research he samples from the selected water points were taken during 6 months (July to December 2012). Totally 10 parameters were tested. These are temperature, dissolved oxygen (DO), pH, EC, COD, NO_3, NO_2, NH_4, SO_4 and PO_4. The highest Level of temperature was 31.7 °C in July for station 4, dissolved oxygen (DO) was 9 mg/L in December for station 1, November and December for station 2, October and December for station 3, October and December for station 4 and December for station 5. The highest Level of pH was 8.62 in December for station 4, EC was 47700 in August for station 2, COD was 5200 mg/L in September for station 2, NO_3 was 75 mg/L in November for station 2, NO_2 was 0.57 mg/L in August for stations 3 and 5, NH_4 was 0.196 mg/L in August for station 4, SO_4 was 4470 mg/L in August for station 2 and PO_4 was 4 mg/L in December for station 2.

***Corresponding Author:** Tirdad Maghsoudloo ✉ tirdad_m@yahoo.com

Introduction

Water is among the most significant resources that must be preserved. This fact is more highlighted when we consider that Iran with current population growth is anticipated to be involved with water crisis by the year 2025. Rivers are considered as the main water suppliers for human uses (Mehrdadi *et al.*, 2006)

The discharge of untreated and cleaned municipal wastewater into rivers leads to increased contamination from organic and inorganic substances. Additionally, wastewater contains a variety of potential human pathogenic parasites, bacteria, and viruses. Therefore, permanent contamination may occur in river and stream reaches below municipal discharges. If organic matter such as untreated human or animal waste is placed into a surface water body, dissolved oxygen levels diminish as micro-organisms grow, using the organic matter as an energy source and consuming oxygen in the process (Fetter, 2007).

Under these conditions, self-purification is a process for the preservation of the ecological balance. Self-purification power is therefore a main parameter for describing the function ability of the ecosystem. The ability of an ecosystem to respond to external pollution and external materials and to preserve ecological structures, is named stability (Heidenwag *et al.*, 2001).

The extent of self-purification in any stream depend on certain factors, some of which are: temperature, level of river, river velocity, amount of inorganic compound in the stream and the arrow, distribution and types of aquatic weeds along the channel.

Accordingly, paying special attention to non-point pollution sources seems to be inevitable. So, the aim of this study is to determine self-purification power of Mond water.

Material and methods

The study area

Mond River located in Bushehr province and is the most important water supply resource in the Mond protected area, and therefore the water quality of the area depends on the water quality of the river. The location of study stations and location of geographical stations is shown in Fig.1.

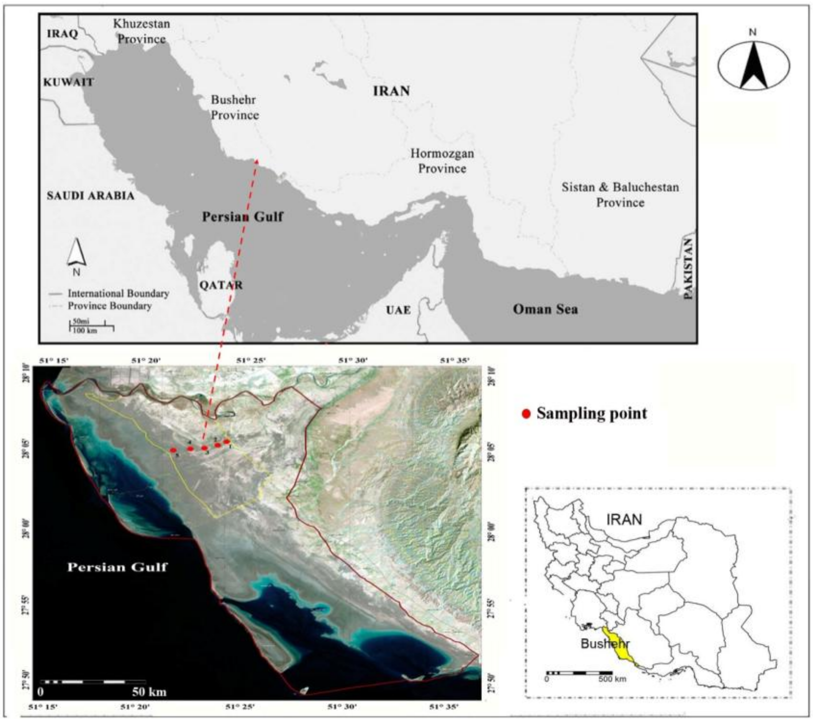

Fig. 1. Location of Mond River and sampled stations.

Water sampling and analysis

After a preliminary assessment of the river channel, 5 sampling points were chosen at intervals from the source to the point closer to the rivers mouth.

The samples from the selected water points were taken during 6 months (July to December 2012). Samples were taken in plastic water bottles. Totally 10 parameters were tested. These are temperature, dissolved oxygen (DO), pH, EC, COD, NO_3, NO_2, NH_4, SO_4 and PO_4.

Results

All the chemical parameters vary in the concentration especially as shown in Table 1 and Fig. 2. The value Mean of NO_3 in all stations increased from 15.9mg/L in July to 28.6mg/L in September. This later decreased to 22.4mg/L in October. The mean increased in November to 36.0mg/L and decreased again to 24.6mg/L in December. The value Mean of NH_4 decreased from 0.0477mg/L in July to 0.0003mg/L in September, after that it increased to 0.0026mg/L in October. Finally the value decreased to 0.0011mg/L in December. The value Mean of SO_4 increased from 1504mg/L in July to 2532mg/L in August, after that it decreased to 1586mg/L in October. The value it increased to 1668mg/L in November. Finally the value decreased to 512mg/L in December. The value Mean of PO_4 decreased from 0.220mg/L in July to 0.025mg/L in September, after that it increased to 0.173mg/L in October. The value decreased to 0.104mg/L in November. Finally the value increased to 1.6mg/L in December. The value Mean of NO_2 increased from 0.060mg/L in July to 0.342mg/L in August, after that it decreased to 0.051mg/L in September. Finally the value increased to 0.120mg/L in December.

Table 1. physical-Chemical parameters variation in Mond River.

St	Month	pH	EC	COD	DO	Temp	NO_3	NH_4	SO_4	PO_4	NO_2
1	July	8.44	17670	600	8.29	31.3	12	0.0426	1020	1	0.3
	August	8.54	20700	336	9	30.7	12.2	0.00091	1070	0.0616	0.548
	September	8.22	21900	200	8.5	28.9	25	0.0003	1980	0.03	0.209
	October	8.33	19900	1000	8.87	26	17	0.0006	1720	0.103	0.082
	November	8.52	18700	520	8	23.8	36	0.001	1490	0.083	0.193
	December	8.42	4470	100	9	18.3	18	0.00058	395	1	0.287
2	July	8.2	14210	228	8.57	30.3	22	0.163	1350	0.026	0.001
	August	7.96	47700	208	8.83	28.9	31.8	0.0002	4470	0.0306	0.022
	September	8.25	44100	5200	8	27.8	53	0.00025	4360	0.0341	0.0112
	October	8.5	34000	200	8.3	25	38	0.003	1760	0.053	0.07
	November	8.22	33700	2000	9	23.1	75	0.004	2450	0.174	0.214
	December	7.73	14400	1800	9	18.5	48	0.0026	675	4	0.175
3	July	8.08	17530	200	8.64	27	26	0.0105	1690	0.0274	0.001
	August	7.81	33900	208	8.9	25.6	1	0.00065	2890	0.0548	0.57
	September	8.11	25000	720	6.9	29.6	31	0.00031	2680	0.0282	0.0243
	October	8.28	27200	1440	8.94	23.1	24	0.003	1650	0.394	0.08
	November	8.47	20000	140	7.39	21.2	32	0.001	1580	0.092	0.084
	December	8.26	12500	200	5.61	20.5	26	0.0006	550	0.0042	0.0283
4	July	7.96	2660	60	8.54	31.7	1.5	0.0074	850	0.0136	0.001
	August	8.4	2790	12	8.9	31	21	0.196	1860	0.041	0.516
	September	7.97	2670	8	7.15	30.4	10	0.00054	1020	0.0126	0.0017
	October	8.31	2490	52	9	27.3	11	0.0038	1150	0.068	0.151
	November	8.43	2590	28	8.5	23.9	15	0.001	1500	0.079	0.009
	December	8.62	600	20	9	17.5	15	0.00107	370	1	0.218
5	July	8.01	10250	180	8.53	31	19	0.0152	2610	0.0333	0.001
	August	8.47	21000	32	8.84	30.4	21	0.00065	2370	0.0494	0.57
	September	8.15	22200	320	8	28.2	24	0.00035	2130	0.0226	0.114
	October	8.47	21900	120	8.84	26	22	0.003	1560	0.0248	0.132
	November	8.32	4850	80	8.5	22.6	22	0.002	1320	0.096	1.03
	December	8.24	4890	100	9	18.9	16	0.00074	570	2	0.288

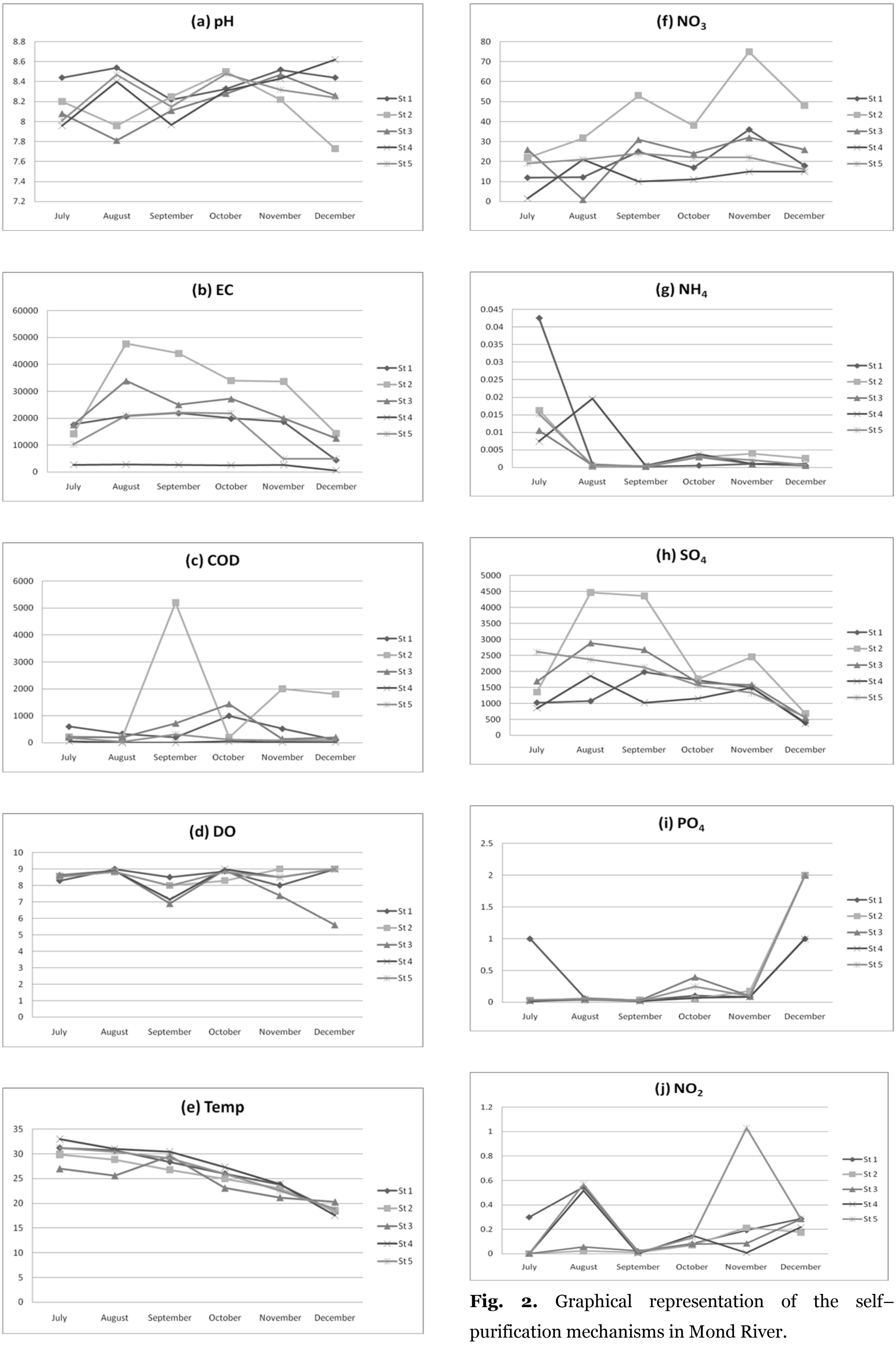

Fig. 2. Graphical representation of the self–purification mechanisms in Mond River.

Discussion

Many physical, chemical, and biotic processes are important determinants of water quality and water purification in aquatic ecosystems (Dame, 1996; Dame *et al.,* 2001; Ostroumov, 1986; Ostroumov, 2004; Sushchenya, 1975; Ostroumov, 2001). Many of these physical and chemical processes are either controlled or affected to a certain degree by biological factors. For example, the rate of the sorption of pollutants by settling particles of suspensions depends on the concentration of phytoplankton cells. Furthermore, photo-chemical decomposition of substances (Schwarzenbach *et al.,* 2003) is only possible in transparent water, and the transparency is ensured by the filtration activity of aquatic invertebrates. Thus, biotic processes are pivotal for most of the processes of water self-purification.

The dominant processes of the self-purification of aquatic ecosystems are (Ostroumov, 2004): (1) filtration activity or "filters"; (2) mechanisms of transferring or pumping chemical substances between ecological compartments (from one medium to another); and (3) degradation of pollutant molecules. Each of the processes is defined or commented in following sections. Filters comprise the following functional systems: (a) all invertebrate filter feeders; (b) macrophytes, which take up and sorbs part of the nutrients (including N, and P) and pollutants entering the ecosystem from adjacent areas; (c) benthos, which takes up, consumes, and sorbs part of the nutrients and pollutants at the water–bottom sediment interface; and (d) microorganisms adsorbed on suspended mineral and organic particles moving relative to the mass of water due to gravity, which is equivalent to filtration through granular substrate with attached microorganisms, the latter taking up and sorbing dissolved organic compounds and nutrients from the water (Ostroumov, 2001).

Ecosystems receive energy for biotic self-purification from photosynthesis, oxidation of autochthonous organic compounds, and other redox reactions. Thus, almost all available sources of energy are involved. Some energy is obtained from the oxidation of the components (dissolved and suspended organic matter) that have to be removed from the ecosystem. In other words, the energetics of selfpurification resembles energy-saving technologies invented by humans.

Almost all organisms involved in intense self-purification activity are under the dual (often multiple) control of the preceding and the next links of the food chain.

Various signals, including chemical information carriers, are involved in the regulatory mechanisms of ecosystems. These chemical substances were termed ecological chemoregulators and ecological chemomediators (chemotransmitters) (Ostroumov, 1986). The influence of regulatory factors on the organisms involved in water quality self-restoration explains why the observed rates of some self-purification processes are considerably lower than the maximal rate of which the aquatic organisms are capable. For example, the rate of water filtration observed in natural water bodies is not high enough to remove all or virtualy all suspended organic matter (particles) from the water. In many filter feeders, the filtration rate decreases with an increase in the concentration of sestonic particles (Sushchenya, 1975).

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