

Evaluation of the Microbial and Chemical Quality of Seawater on the recreational area of Port Assaluyeh

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ABSTRACT:

Introduction: Accompanied by the industries development in Asalouyeh, natives and immigrants who live in this area and also travelers who come to the Asalouye's beaches and promenades around it for swimming and recreation are worried about the pollution of seawater through entering industrial effluents and urban sewage. Swimming is a healthy activity for whole body workout and strengthening the cardiovascular system which can be continued throughout life. Therefore, the southern coasts of the country host many travelers from different parts of the country during Nowruz and weekends. However, the health of swimmers and ecology in natural natatoriums are generally influenced by the discharging of industrial and urban wastewater. **Methodology:** This study measured 6 swimming spots on the beaches of Asalouyeh, Nakhil Taghi, Bonood, Haleh, and Nayband and also downstream beaches of Asalouye's refineries and petrochemicals. The chemical and microbial quality of these areas was investigated and compared with the existing standards. The samples were taken in the autumn of 1402 according to the standard method of seawater sampling from 30 cm depth below the water surface and at a distance of 5 meters from the land. The samples were collected in sterile bottles and stored in a cold box until reaching the laboratory. The determination test of bacteria and heavy metals was done according to the standard methods of water and wastewater. **Results:** The points under study were free of total coliform in terms of bacteriology and heavy metals such as zinc, iron, chromium, and copper were within the permissible limits, and lead, cadmium, and nickel were higher than the standard of the World Health Organization (WHO). The high concentration of these metals in all sampled stations can be due to the entry of industrial effluents. **Conclusion:** Among the heavy metals, lead, cadmium, and nickel have harmful effects on human health and cause cancer. Also, lead contamination causes damage to kidney function and the cardiovascular system, preventing hemoglobin synthesis, and damage to the central nervous system, joints, and reproductive system. Although the samples were free of microbial contamination and other metals measured within the permissible limits, nevertheless, it is necessary to measure bacteriology and heavy metals continuously in different seasons due to the development of industries and the density of the urban population in Asalouyeh.

Keywords: Asalouyeh, Recreation, Total Coliform, Heavy Metals, Persian Gulf

INTRODUCTION:

Swimming is one of the least dangerous and at the same time the best sports for humans and you can use all the muscles without harming the joints and bones, the heart, lungs, muscles, etc. are strengthened by swimming without harming the bones and joints. This exercise reduces excitement and anxiety and leads to relaxation. Consequently, elderly people and children are very interested in swimming for soul and spirit

refreshment and physical fitness. It is said that one hour of swimming training burns several calories equal to one hour of running without any negative effects on bones and joints. Unfortunately, the entry of sewage into the sea affects the health of swimmers and aquatic animals. Therefore, the detection of pollution in recreational beaches is of particular importance. Many pathogenic microorganisms may enter swimming pools through municipal sewage and cause various skin, digestive, and respiratory diseases, eye and ear

infections, and diarrhetic diseases. Total Coliform (*E. coli*, *Citrobacter*, and *Enterobacter*) is one of the most important index bacteria in natatoriums water. Heavy metals are another important factor of sea water pollution which entered into natural water sources through agriculture (wastewater containing pesticides poison and chemical fertilizers) and industrial wastewater and they are important because of their toxic effects and cumulative properties in the body of aquatic animals and entry into the food chain.

Some of the heavy metals are necessary for the growth and development of living organisms, but if the amount of these elements exceeds the standard concentration, it will disturb the ecological balance and endanger aquatic life. The most toxic heavy metals in the environment include lead, mercury, cadmium, and nickel which are harmful to humans and other creatures even in small amounts. The high concentration of these toxic metals in natural waters is usually related to various industries and agriculture.

Table 1- The standards of the World Health Organization (WHO) and Public Health Service of America (PHS) for heavy metals in natural waters

Row	Heavy metal name	Permissible limit(PPM ¹)
1	Lead	0.05
2	Iron	5
3	Chrome	0.05
4	Zinc	1.5
5	Copper	1.5
6	Cadmium	0.01
7	Nickel	0.07

Method of work:

This study was conducted to assess the microbial and chemical quality of the water of recreational areas of Persian Gulf in Asalouyeh in the 1402 solar year. At first, swimming areas and areas that host more swimmers were selected as sampling sites. The geographic location of the sampling stations is shown in Figure 1. 6 sampling stations including the beaches of Asalouyeh Park, Nakhil Taghi Park, Nayband, Bonood, and two points downstream of petrochemicals and refineries were selected as sampling locations. Water samples were taken from a depth of 30 cm from the water surface and a distance of 5 meters from the land. A microbial sample was taken from each station in a 500cc sterile container and a chemical sample in a 1.5-liter polyethylene bottle and they were kept in a cold box until reaching the laboratory.

Determination of total coliform bacteria (MPN) and the measured heavy metals (lead, cadmium, chromium, iron, zinc, copper, and nickel) in each sample was done according to standard water and wastewater methods. The total number of coliforms

was tested through the 9-tube fermentation method and Lactose Broth culture medium (probable stage) and no bubbles were formed in all 6 samples following 48 hours in the incubator at 35.5 up to 37 degrees Celsius. In other words, it was free of coliform. Also, heavy metals were measured using an atomic-absorption device and the results of this study were compared with the standards of the World Health Organization and the American Public Health Service.

Findings and discussion:

In the current study, total coliform bacteria were not detected in all 6 water samples of the considered natatorium on the beaches of Asalouyeh; In other words, the absence of gas and turbidity in the Durham Pipe indicates the absence of coliform bacteria. Therefore, the water samples of the recreational areas under study were all desirable in terms of total coliform contamination. The reason for the absence of coliform in the water of these beaches could be the less discharge of municipal sewage, paying attention to environmental protection and the creating of health facilities on the beaches, or the fact that the sun's ray plays an effective role in destroying bacteria and can reduce the amount of pollution.

Even though all the evaluated stations at the probable stage were free of coliforms according to the results of the microbial assessment (table 2), most parts of beaches in Asalouyeh including Nakhil Taghi, Bonood, Hale, and Nayband lack adequate facilities, and sanitary facilities including sanitary toilets, trash cans, sanitary taps, and sanitary sewage disposal based on conducted studies. These factors can contaminate the water of the beaches in terms of bacteria in the future. Therefore, it is necessary to equip these beaches with sanitary facilities to prevent pollution and endangering the swimmers' health.

Based on the obtained chemical results in this research (table 2) and the comparison of the average heavy metals found in these beaches with the standard of the World Health Organization for natural waters, it can be found that Cr, Fe, Zn, and Cu are lower than the permissible and Pb, Cd and Ni are higher than the permissible limit in all stations. Heavy metal pollution can be penetrated due to industrial, urban, and agricultural effluents, petroleum, and oily substances resulting from the balance of ships and fishing barges to the waters of these beaches and affecting the living environment of aquatic animals and natatoriums. Therefore, an annual routine assessment of toxic metals and petroleum substances in beaches and urban and industrial effluents is necessary. The sampling points include Bonood Beach SP1, Nayband Beach SP2, Asalouyeh Beach SP3, Nakhil Taghi Beach SP4, Refineries Beach SP5, and Petrochemicals Beaches SP6. The results of the conducted tests are described in the table below.

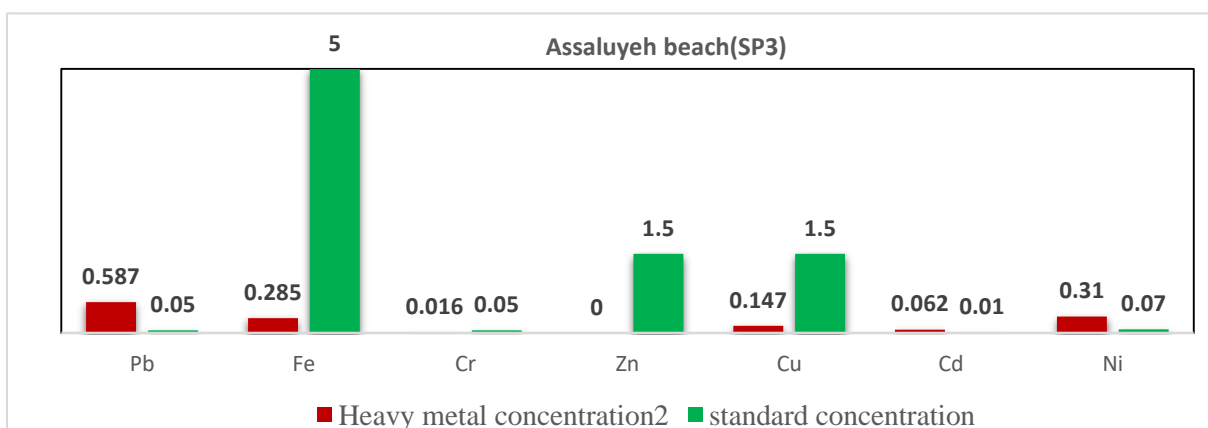
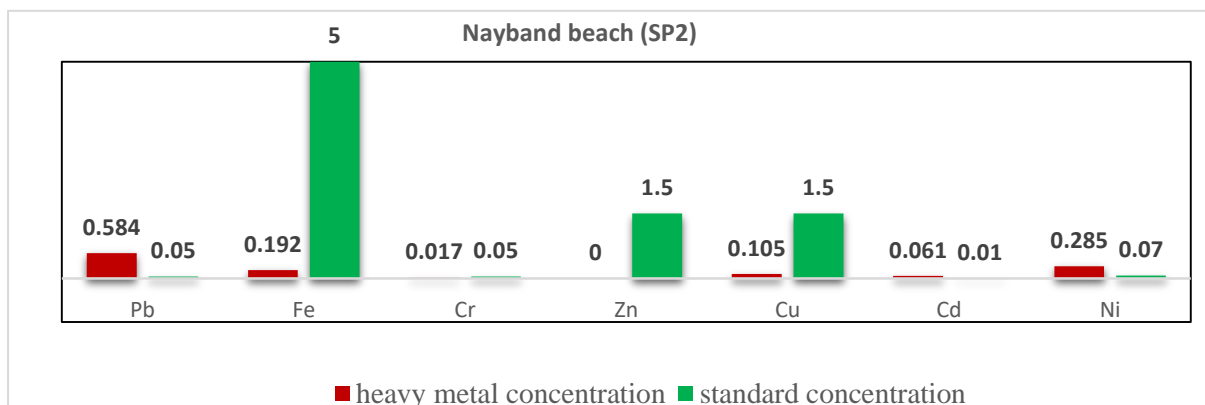
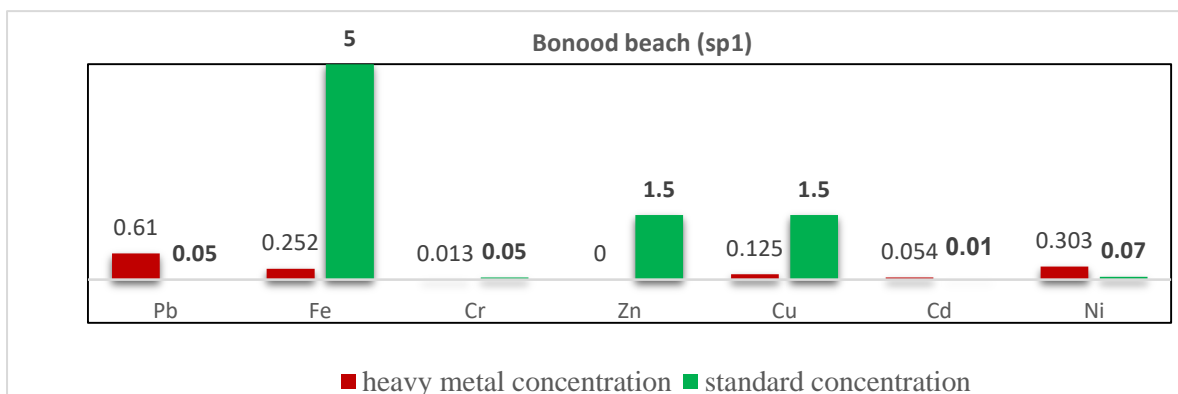
¹ Parts per million: A measurement of concentration on a weight or volume basis

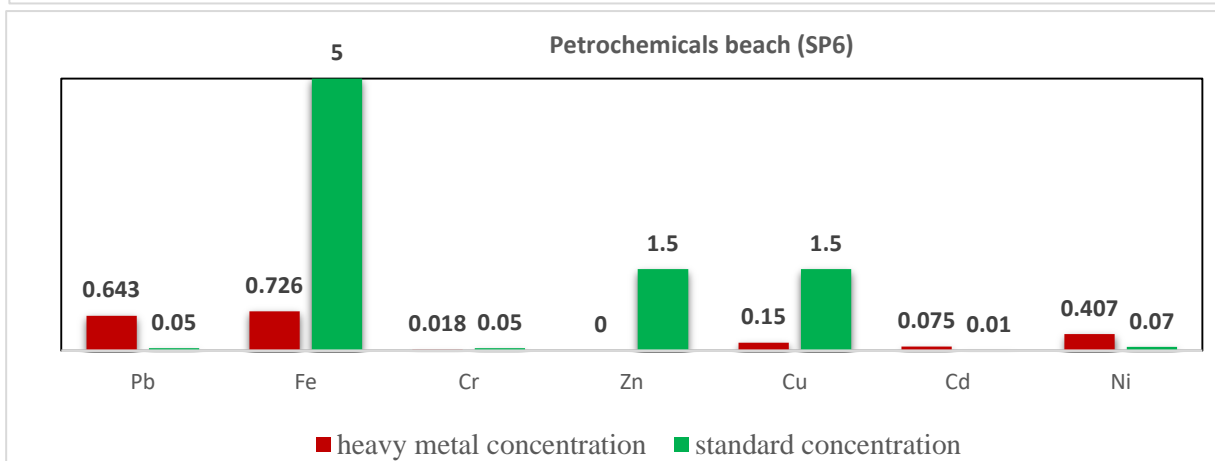
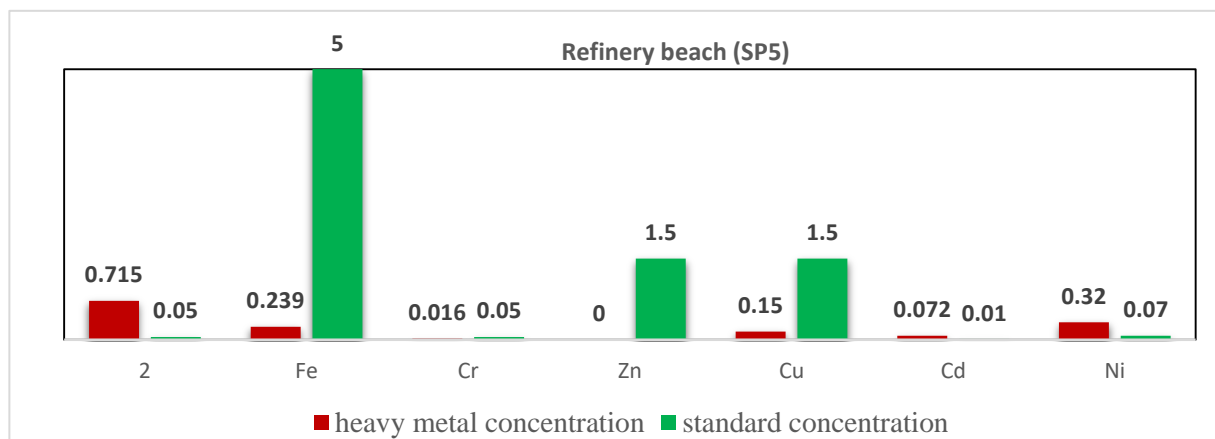
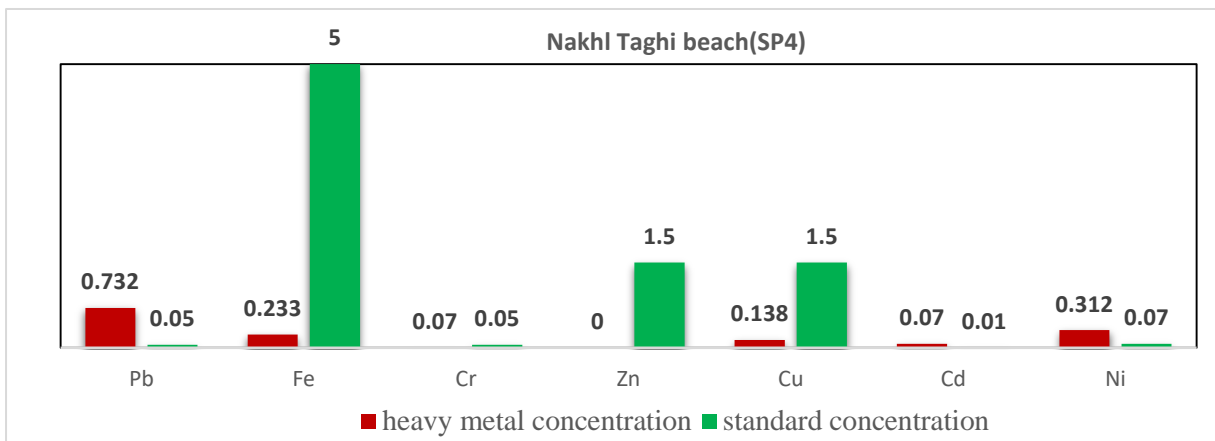
Table 2- The results of chemical and microbial tests of seawater in Asalouyeh

Heavy metals name	Sampled sites						Standard concentration (PPM)
	SP1	SP2	SP3	SP4	SP5	SP6	
Pb	0.61	0.584	0.587	0.703	0.715	0.643	0.05
Fe	0.252	0.192	0.285	0.233	0.239	0.726	5
Cr	0.013	0.017	0.016	0.007	0.016	0.018	0.05
Zn	0	0	0	0	0	0	1.5
Cu	0.125	0.105	0.137	0.138	0.15	0.15	1.5
Cd	0.054	0.061	0.062	0.07	0.02	0.075	0.01
Ni	0.303	0.285	0.31	0.312	0.32	0.307	0.07
MPN	ND	ND	ND	ND	ND	ND	

In the following diagrams, the average concentration of heavy metals in the sites sampled from the beach water has been compared with the standards of the World Health Organization (WHO) and the American

Public Health Service (PHS). As said, lead, cadmium, and nickel are above the existing standards in all stations.





Surfer16 software has been used in the topographic maps below to process and analyze the data obtained from the sampling points. Following the calculation of the desired stations' information, this software has shown as a light shade that the concentration of lead in the beaches of the refineries and Nakhl Taghi beaches was the highest and in the beaches of Nayband and Asalouyeh the lowest among the 6 samples. The distance from the oil and gas industries has had an effect on the pollution of coastal water with lead.

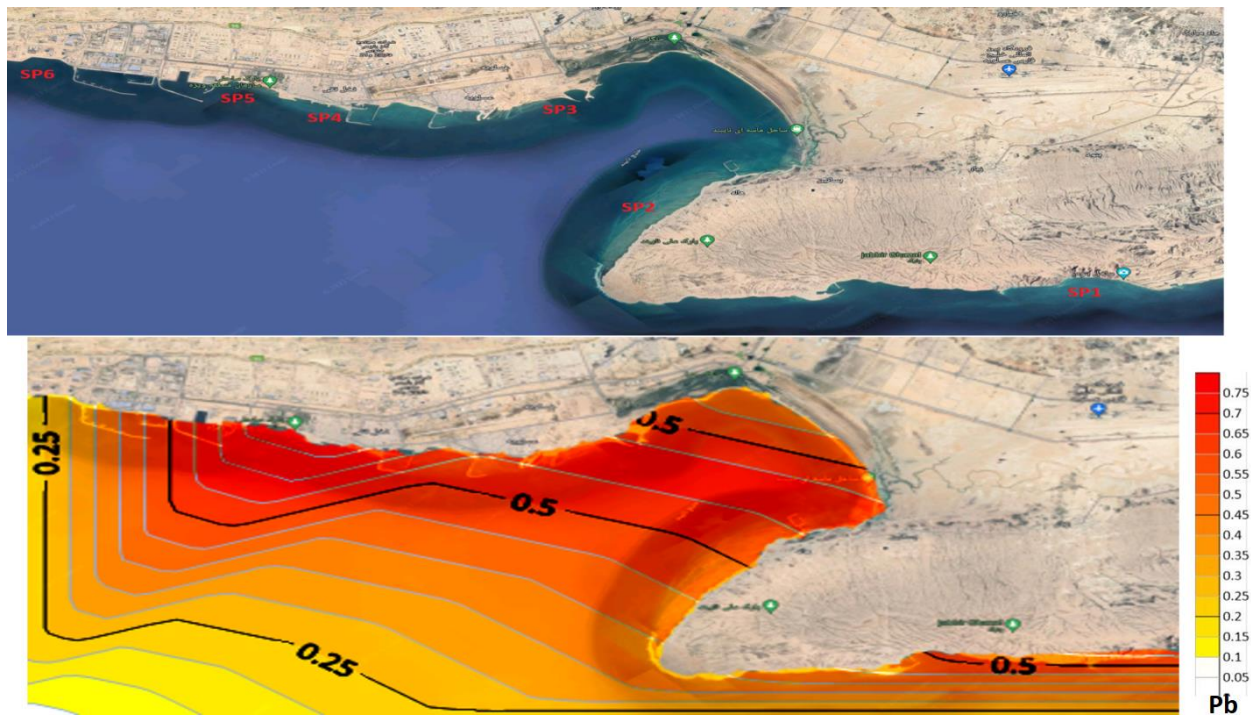


Figure 1- The geographic location of the sampled sites and the amount of lead concentration in each station

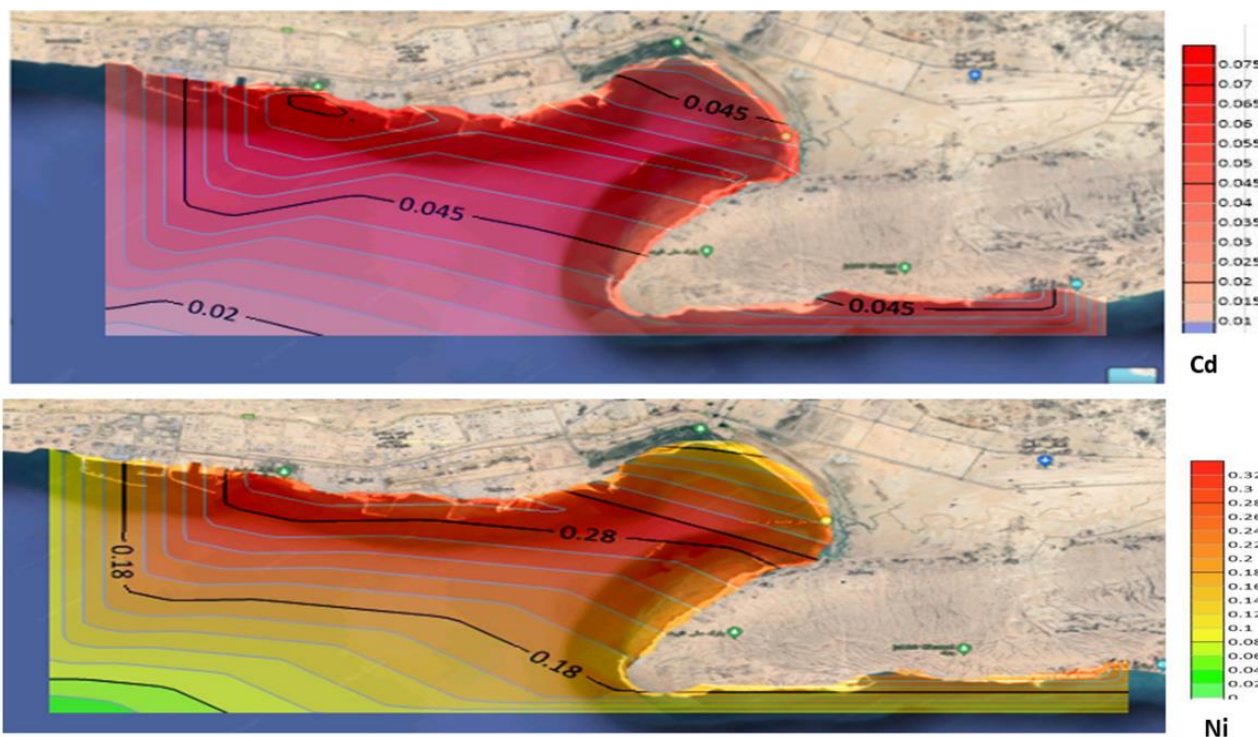


Figure 2- The amount of cadmium and nickel concentration in each station compared to other station

As observed in the above maps (figure 2), we see the lowest concentration of cadmium on the beaches of Bonood and Nayband and the highest concentration on the downstream beaches of refineries and petrochemicals among the 6 stations. It may be due to the industries activity and the resulting pollution, and quite logically, Bonood and Nayband beaches have the lowest cadmium concentration among the 6 measured samples because of the long distance from the

industries. The nickel concentration is almost equal in all the stations on the beaches under study. Obedi et al. conducted a study regarding the investigation of heavy metal pollution in the waters of Asalouyeh Port and its impact on the muscles of *Scomberomorus guttatus* (Ghobad fish) and *Cynoglossus arel* (Kafshak fish) and its results showed that all the elements around the South Pars power plant are above the existing standards' permissible limits

and they found out that the water pollution is very high in this area. Given that the habitats of these two fishes are different (*Scomberomorus guttatus* lives near the surface of the water and *Cynoglossus arel* lives in the depths of the water), consequently, the amount of pollution in the *Cynoglossus arel* is higher than *Scomberomorus guttatus* because they live in the depths where the water pollution caused by the power plant is higher and it will poison the fishes and enter into the people's food cycle.

Dobaradaran et al. conducted another study on the microbial and chemical quality of natatoriums' water of Persian Gulf on the shores of Port Bushehr and its results showed that the average microbial indicators in all stations are higher than the standard, but the average heavy metals in all samples is lower than which shows more discharge of municipal wastewater compared with industrial one. Compared to the present research, we can conclude that most of the pollutants entering the sea in Asalouyeh beaches are heavy metals resulting from industrial activities and pollution of beaches in Bushehr is due to urban sewage discharge.

CONCLUSION:

Some of the heavy metals mentioned in this research were higher the existing standards and also from the low load of microbial contamination, it can be concluded that the entry of industrial wastewater into the recreational areas and swimming areas is more compared with urban wastewater. In the end, referring to the explanations given regarding the improvement of the health quality of the recreational areas around Asalouyeh, it is suggested to increase the number of points and the sampling period in the next studies due to the high level of some heavy metals. Also, other chemical and microbial parameters of water should be investigated.

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