

Heavy Metal Pollution and Chemical Profile of Ceyhan River (Adana-TURKEY)

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Received 21.08.1998

Abstract

This study has been performed to investigate geochemical aspect of Ceyhan River water. Parameters searched annually were anions, cations, some trace elements, pH, EC, T°C and salinity.

Annual fluctuations of the major dissolved constituents were obtained, chemical and utilization classifications were carried out. Water samples have high carbonate hardnesses. Main ions are in the following order: $rCa \geq rMg > r(Na+K)$ and $r(HCO_3+CO_3) > rSO_4 > rCl$.

Although, the quality of Ceyhan river may be classified as very good-good based on the salt and sodium for irrigation, Cd concentration exceeded the upper limit of standards.

Concentrations of all elements and ions increase downstream with little deviations. About 100% of Mn, Cu, Ni, Cr, Cd, Co, and 99% of Zn, Pb, Al elements are held on suspended matters.

Key Words: Heavy Metals, Water Pollution

Ceyhan Nehrinin Ağır Metal Kirliliği ve Kimyasal Profili (Adana-TURKEY)

Özet

Bu çalışma Ceyhan Nehri sularının jeokimyasal özelliklerini araştırmak amacıyla yapılmıştır. Yıllık olarak incelenen parametreler; anyonlar, katyonlar, bazı iz elementler, pH, T°C ve tuzluluktur.

Çözülmüş ana bileşenlerin yıllık değişimleri ortaya konmuş, kimyasal ve kullanıma uygunluk sınıflamaları yapılmıştır. Genel olarak su örneklerinin karbonat sertliği yüksektir. Ana iyon dizilimleri: $rCa \geq rMg > r(Na+K)$ ve $r(HCO_3+CO_3) > rSO_4 > rCl$ 'dir.

Ceyhan Nehri suyu orta tuzlu düşük sodyum içeriği olan çok iyi-iyi su kalitesinde olmasına rağmen, Cd konsantrasyonu sulama suyu standartlarını aşmaktadır.

Tüm element ve iyon konsantrasyonları küçük sapmalarla kaynaktan uzaklaştıkça artmaktadır. Ağır metallerden Mn, Cu, Ni, Cd ve Co'nun yaklaşık % 100'ü, Zn, Pb ve Al'un %99 kadarı asılı katılarda taşınmaktadır.

Anahtar Sözcükler: Ağır metaller, Su kirliliği

1. Introduction

Southern Anatolian surface runoff is discharged into the İskenderun Bay by means of the Ceyhan River. Main settlements are Kahramanmaraş city

and, Ceyhan, Kadirli, Afşin, Elbistan, Bahçe, Osmaniye and Kozan Villages.

This study has been performed, hence the agri-

cultural activities are present in almost four seasons in Çukurova, and the fresh water supply of the Middle East is limited. Some agencies of Turkish Government such as the State Hydraulic Works monitor routinely the major ion chemistry of the rivers. However, toxic metals are not considered in many studies.

Many rivers have high heavy metal concentrations. There are several times increase in heavy-metals in Cauvery river (Vaithyanathan, 1993) and Osaka bay sediments (Hoshika and Shiozowa, 1986) in recent years.

Concentrations of the heavy metals are under the influence of pH, rainfall, etc. High concentrations and abundance of releasable forms of Pb and Cd are dangerous for environment (Pardo, 1990).

2. Materials and Methods

River water samples were collected in polyethylene bottles from 5 stations along waterway. Each locality was sampled once in a month between April 1994-March 1995. pH, salinity, and electrical conductivity were measured with a YSI 33 model portable conductivitymeter.

Samples were filtered through 0.45 μm Millipore filter paper. They were concentrated 5 times by evaporation method for heavy-metal analyses. All samples were preserved at 4°C. Heavy-metals (Fe, Mn, Cu, Zn, Si, Ni, Cd, Al, Pb, Sb, Sr, Cr and Co), Ca and Mg were detected by A.A.S. Na and K have been analyzed by flame-photometer, SO_4 by gravimetric, CO_3 , HCO_3 and Cl by volumetric methods. To check the accuracy and precision of the measurements Merc standard solutions with known concentrations were analyzed.

3. Discussions

Water and suspended matter chemistries of the Ceyhan River were evaluated (Yilmazer, 1996).

3.1. Water Chemistry

According to the major ion composition, samples are in zone 5 which is characterized by composition where the carbonate hardness exceeds 50%. Only February have carbonate alkaline character over 50%. Ca and Mg concentrations of February are lower than the average of the other months. HCO_3 and CO_3 concentrations indicate the fresh rain-water income with high carbonate and bicarbonate ions.

The decrease in pH supports this idea (Yilmazer, 1996).

The general arrangements of the major constituents are as follows; $r\text{Ca} \geq r\text{Mg} > r(\text{Na}+\text{K})$ and $r(\text{HCO}_3\text{CO}_3) > r\text{SO}_4 > r\text{Cl}$. So, the source and/or the basins are dominated by dolomitic limestone, and/or the rocks rich in Mg content. Ceyhan River water has calcium, magnesium carbonate character.

If the data are compared with the criteria, given in the Water Pollution Control Regulations of Turkish Ministry of Environment Official Gazette (1988), water can be classified as contaminated with Fe, Al, and Ni, and excessively contaminated with Pb, and Cd elements.

3.2. Drinking Water

Drinkability of the Ceyhan River water was tested by comparing with the T.S.E. (Şahinci, 1991) and WHO (Tebbut, 1977) drinking water standards. Pb, and Fe exceeds the upper limits of both. Cd concentrations have values over the WHO standard, while T.S.E. Standard does not take it into consideration. Iron gives only a metallic taste to the water, but the others are harmful for human body.

3.3. Irrigation Water

Based on the USA salinity diagram, the Ceyhan river water has C2S1 character, that with a medium salt-minor sodium content, can be used for all types of soils and plants. Samples of February have C2S2 character with medium salt and sodium content, can be used for well drained soils (Yilmazer, 1996).

Cd element concentration of water exceeds the upper limit of irrigation water standards (Ayers & Westcot, 1976).

3.4. Usability In Industry

Industrial water must have some special characteristics according to the type of the industry. Lime, corrosion and sometimes sulfate are the parameters that affect the usability of the water. High iron and manganese levels are objectionable in water supplies. They cause stain laundry, and plumbing fixtures, and in the case of manganese, fosters the growth of microorganisms in distribution systems. Water with high Fe, Mn and turbidity are not allowed in textile, leather, paper and food industries.

Ceyhan River water have carbonate soluble character, except some samples of sixth and second

months. Due to the low sulfate content (about 60-65 mg/L) it can be used for construction (Yilmazer, 1996).

3.5. Suspended Matters

The heavy-metal concentrations of suspended matters have higher Fe, Cd, Ni, Co and Pb concentrations than many world rivers (Yilmazer and Yaman, 1997). About 100% of Mn, Cu, Ni, Cr, Cd and Co elements are held on suspended matters. Zn, Pb and Al are below 1% in solution (Yilmazer, 1996).

Suspended matters have higher heavy-metal concentrations than the standart soils. Some of these concentrations are related with the lithologies in contact with the water body.

The concentrations of heavy-metals in suspended matters as follows; Al>Mn>Ni>Cr>Pb>Zn>Co>Cu>Cd. Zn, Pb and Cd concentrations of suspended matters are higher than those of the lithologies making contact with river. Yaman (1994) showed that, the Pb concentrations of roadside soils reach up to 20 times greater than that of the standard soils. These high concentrations may be related with the Pb in exhaust gases of vehicles and Cd in phosphate fertilizers.

Conclusion

Water characteristics of the Ceyhan River exhibit seasonal variations. Major cations and anions as follows; $rCa \geq rMg > r(Na+K)$ and $r(HCO_3+CO_3) > rSO_4 > rCl$.

When the data are compared with the Water Pollution Control Regulations of Turkish Ministry of Environment Official Gazette (1988), water can be classified as contaminated with Fe, Al, and Ni, and excessively contaminated with Pb, and Cd elements. The amount of suspended matter, Pb, Fe and Cd elements do not permit it to be used for drinking purposes. However, the Cd element concentration exceeds the allowable limit of irrigation waters, salinity of the water is suitable for irrigation purpose. Due to the high carbonate, Fe Mn and turbidity values, the water can only be used in construction industry.

Suspended matters have high concentrations of Zn, Pb, and Cd heavy-metals, and have clues of anthropogenic pollution. Order of the heavy metals is suspended matter is Al>Mn>Ni>Cr>Pb>Zn>Co>Cu>Cd. Possible reasons for pollution are vehicle fuel remains and phosphate fertilizers.

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