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Heavy Metals Analysis in Water Samples from Godavari River at Rajahmundry Region by using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)

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Abstract Inductively Coupled Plasma- Optical Emission Spectrometer (ICP-OES) is one of the most widely using technique for determination of multi-elements in various environmental matrices in single aspiration. The present study was conducted to investigate the trace metal contents (Cr, Cu, Ni, Pb, Zn, Fe) of water samples, which were collected from 5 different sites along the river Godavari in Rajahmundry region by using ICP-OES technique.

Keywords Heavy metals, ICP-OES, elements, Godavari river

Introduction

Godavari water plays an important role in the life of peoples and animals on the bank of the river Godavari. It is widely used as a source of water for drinking, irrigation and other purposes [1]. Within the state of Andhra Pradesh, it flows through hilly terrain of the Eastern Ghats known as the Papi hills which explains the narrowing of its bed as it flows through a gorge for a few km, only to re-widen at Polavaram. The deepest bed level of Godavari River, located 36 km upstream of Polavaram dam, is at 45 meters below the sea level [2,3]. Before crossing the Papi hills, it receives its last major tributary Sabari River on its left bank. The river upon reaching the plains begins to widen out until it reaches Rajahmundry. At Rajahmundry, the Godavari splits into two branches which are called Vriddha Gautami and Vasishta Godavari. Again, the Gautami branch splits into two branches namely Gautami and Nilarevu. Similarly, the Vasishta splits into two branches named Vasishta and Vainateya. These four branches which join the Bay of Bengal at different places, form a delta of length 170 km along the coast of the Bay of Bengal and is called the Konaseema region. The industrial effluent has great potential for polluting the water. The industrial wastes may have pollutants. The industrial effluent affects the river water quality, which is not useful for drinking and agricultural purpose. Monitoring and assessment of the water pollution has become a very critical area of study because of direct implications of water pollution on aquatic life and human beings. The contamination of surface water by heavy metals is a serious ecological problem as some of them, like Hg and Pb, are toxic even at low concentrations, are non-degradable and can bio-accumulate through the food chain. Though some metals, like Fe,

Cu and Zn, are essential micronutrients, they can be detrimental to the physiology of the living organisms at higher concentrations [4,5]. Heavy metals are widespread pollutants of great environmental concern, as they are non-degradable, toxic, and persistent with serious ecological ramification on aquatic ecology [6]. The present study was conducted to investigate the heavy metal contents (Cr, Cu, Ni, Pb, Zn, Fe) of water samples in five different sites along the river Godavari in Rajahmundry region.

2. Materials and Methods

2.1 Study area

The Godavari River is basically free of external runoff recharge, and the main body of the river is affected by domestic sewage and industrial wastewater. Rajahmundry is located at 16.98°N 81.78°E with an average elevation of 14 meters (45 feet). It is the fourth largest city in Andhra Pradesh, on the banks of the River Godavari. Rajahmundry also hosts few corporates and multinationals as part of its industrial development, such as: ITC Limited, ILTD Division, The Horlicks Factory (GlaxoSmithKline Ltd), The Coastal Paper Mills (P) limited, The Kadiyam Paper Mills etc., The Central Tobacco Research Institute, Oil and Natural Gas Corporation (Headquarters of ONGC's Krishna Godavari basin), Gas Authority of India Ltd (GAIL), GVK Power Plant- Jegurupadu, Multiple gas based Power Plants by GMR Group, The A.P.Gas Power Corporation Ltd etc., in and around Rajahmundry [7]. Hence the present research work has been taken up to assess the seasonal water quality variation and to forecast the fate of River Godavari due to various developmental activities taking place in and around Rajahmundry. Sample collection Samples were collected from the Godavari River in April 2022. Samples was collected in a polythene container. The sample locations within the study area are shown in Fig. 1 and Table 1.

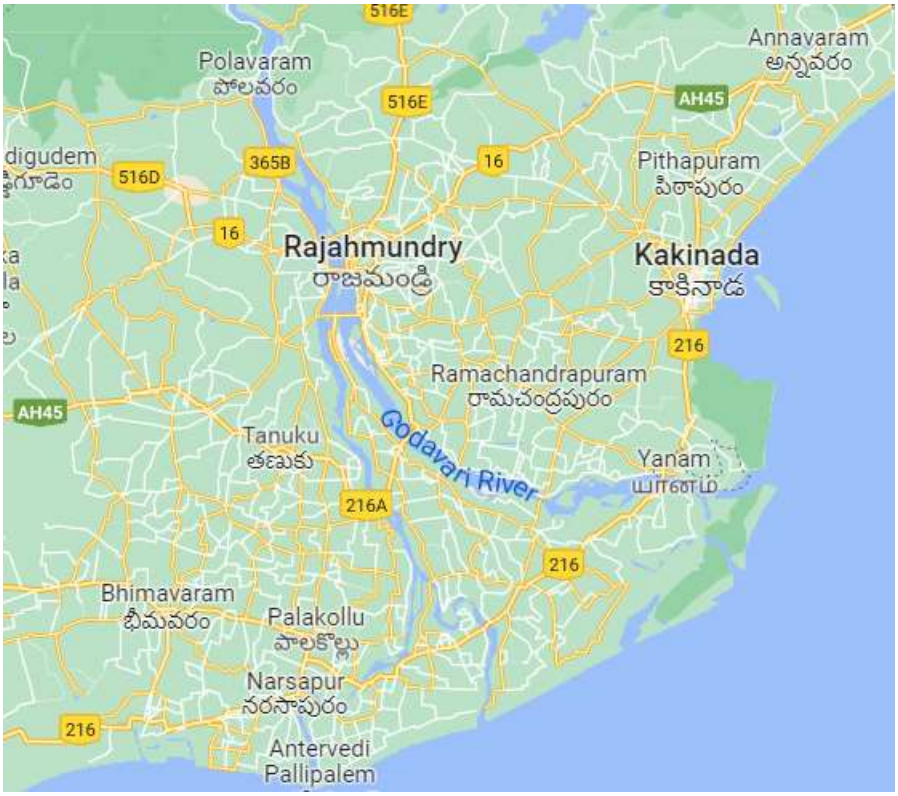

Figure 1: Study area

Table 1: Water quality stations on river Godavari in Rajahmundry

Site number	Name of water quality site	The geographical coordinates of sampling stations
S1	Godavari 4th bridge	latitude — 16° 42' 30.7728" N longitude — 82° 7' 7.2588" E
S2	Godavari Haarthi	latitude — 17° 00′ 27.12″ N longitude — 81° 46′ 00.88″ E
S3	Padmavathi Ghat	latitude — 17°00'00.7"N longitude — 81°46′04.9″E
S4	Kovur bridge view point	latitude — 14° 30' 4.3488" N longitude —79° 59' 17.2644" E
S5	Gowdami Ghat	latitude —16°59'23.29"N longitude — 81°46'31.17"E

2.2. ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry) Analysis of Samples

All samples were analysed in triplicates by ICP-OES Perkin-Elmer; model Optima™ 2000 DV, using winLab32 software for the analysis.

3. Results and Discussion

Heavy metal anomalies in water, may adversely affect human health. The developed method, ICP-OES was applied for the determination of Cr (IV), Cu (II), Ni (II), Pb (II), Zn (II) and Fe (III) in Godavari river water. The values and ranges of element concentrations in the water samples are presented in Table 2. The concentrations of the analysed elements in water samples were as following: chromium ranged between 0.010 to 0.020 mg/L (average value 0.0156 mg/L); copper ranged between 0.018 to 0.03 mg/L (average value 0.026 mg/L); nickel ranged between 0.031 to 0.045 mg/L (average value 0.0382 mg/L); lead ranged between 0.04 to 0.091 mg/L (average value 0.0804 mg/L); zinc ranged between 0.003 to 0.1 mg/L (average value 0.0396 mg/L); iron ranged between 0.004 to 0.03 mg/L (average value 0.0134 mg/L).

Table 2: Elemental concentration in all water samples

No.	Heavy metals	S1	S2	S3	S4	S5
1	Chromium (mg/L)	0.015	0.010	0.014	0.020	0.019
2	Copper (mg/L)	0.018	0.025	0.029	0.028	0.03
3	Nickel (mg/L)	0.036	0.031	0.041	0.038	0.045
4	Lead (mg/L)	0.083	0.091	0.086	0.102	0.04
5	Zinc (mg/L)	0.003	0.006	0.080	0.009	0.1
6	Iron (mg/L)	0.02	0.03	0.01	0.003	0.004

Permissible limits for surface waters according to standards of the World Health Organization shown in Table 3. According to WHO standard, lead metal concentration exceeds in sites S1, S2, S3, S4. The study showed a need for continuous pollution assessment study.

Table 3: Permissible limits for surface waters according to standards **of the World Health Organization [8-10]**

No.	Heavy metals	WHO
1	Chromium (mg/L)	0.05
2	Copper (mg/L)	2
3	Nickel (mg/L)	0.07
4	Lead (mg/L)	0.07

5	Zinc (mg/L)	3
6	Iron (mg/L)	0.3

4. Conclusions

Within the presented project, we studied the concentration of trace metals in the Azerbaijani region of the Kura River. The average concentration of studied metals in water followed a decreasing order of Pb > Zn > Ni > Cu > Cr > Fe in Godavari river in Rajahmundry region. Except Pb metal, other measured metals content in water samples in all sites has been found to be less than the limit recommended by the World Health Organization. It is recommended a constant monitoring of heavy metals concentration in Godavari river, serves as a source for the local inhabitants.

Conflicts of interests

The authors declare no conflict of interest.

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