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Contemporary Status of Heavy Metal Contamination of Groundwater by Cement Industry Activities, Ariyalur District, Tamilnadu, South India

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Abstract: ***This study was focused to reveal the current heavy metal contamination status in groundwater samples collected from Ariyalur district. This research was done at the site of the Cement industries, in Ariyalur district. We investigated only four heavy metals (Cr, Pb, Cu and Zn) contamination in the groundwater samples of research area. Flame AAS (Atomic Absorption Spectrometer) technique was used to determine these four heavy metals concentration. This result showed that Chromium concentration is significantly higher in groundwater samples at the site of the Cement industry locality also Pb, Cu, and Zn metals strength was found to be slightly high in groundwater at the site of the Cement industry areas. These metals contamination in groundwater is answerable for the maintenance of harmfulness in farming crops and domestic use water.***

Keywords: ***Cement industries, heavy metal, groundwater, Ariyalur district***

I. INTRODUCTION

Now a day, environment and health related problems by heavy metal have turn into a major concern. As water is a vital essential of village and urban backgrounds, the function of heavy metals in ground water is more and more becoming an issue of universal anxiety. The contamination of heavy metals in groundwater undesirably hurts its physicochemical criteria vigorous to sterility and smallest amount of crops by their wastes [1, 2]. Current days, with the development of the international economy, groundwater contamination by trace metal has slowly enlarged, ensuing in the worsening of the atmosphere. This groundwater quality is dirtied by heavy metals through the modern irrigation system and various industrial activities; resulting toxicity is received into tropical food chain which disturbs the food quality and protection [3, 4]. Contamination of groundwater by heavy metal due Cement industry wastes and effluents becoming a universal problem. Wastewater from Cement industries, other industries or supplementary sources brings a enormous quantity of heavy metals such as Cr, Cu, Zn, Pb etc. which are responsible for the pollution of groundwater [5, 6]. In our country, Cement industry is a most important money segment. There is large number of Cement industries in Ariyalur district. These industries in Ariyalur district are posing a heavy risk to the environments. During Cement manufacture process, lots of chemicals widely used. Lots of effluents discharged into surrounding during cement manufacturing. Some of the cement factories in Ariyalur district do not have effluent treatment facilities[7 - 9. These Cement industries disposed of their untreated wastes and Cement industry effluent directly to open drain which will be finally connecting to the water bodies and ground. Heavy Metals content in soils may go into the body directly through ingestion, skin contact etc. Heavy Metals in irrigation water are accumulated and absorbed through vegetables and fruits etc. Consumption of heavy metals through water-soil-crop structure is a main technique of destructing human physical conditions [10 -13]. The motivation of this research was present position of heavy metals (Cr, Pb, Zn & Cu) in groundwater and compared these four heavy metals (Cr, Pb, Zn & Cu) contamination of groundwater in the Cement industry areas of Ambur taluk, Ariyalur district, which were not compared in the past studies [14 - 16]. From this research it has been explained that heavy metals contagion in soil has now a day's become a major concern. In a developing country like India, the situation is not better due to deficient of technological improvement. It is clearly evident that the groundwater near Cement industry locality of Ambur, Ariyalur district is moderately to extremely contaminated with Cr, whereas Cu, Pb and Zn are very slightly to uncontaminated. This is due to being exposed to a huge quantity of unprocessed wastes and effluents from the nearby Cement industries day by day [17]. This kind of metal contamination can be suppressed by using some low cost adsorbent that are easily available such as coconut shell, rice husk carbon, fly-ash, charcoal etc. before clearing effluent into surface water body these adsorbent must be used in order to suppress heavy metal adulteration [18].

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II. MATERIALS AND METHODS

Ariyalur district is an administrative district in the state of Tamil Nadu in India. The district headquarters is located at Ariyalur district. The district encompasses an area of 1,949.31 km².Gangaikonda Cholapuram, built by King Rajendra Cholan of Chola Empire, is a UNESCO World Heritage site situated in this district. Ariyalur is noted for its cement industries and Jayankondam has huge reserves of lignite. Ariyalur district was carved out of Perambalur district on January 1, 2001. But, it was merged with Perambalur district on March 31, 2002. Ariyalur district was re-carved on November 23, 2007. The district is bordered by the districts of Cuddalore to the north and north-east, Nagapattinam to the east, Thanjavur to the south and south-east, Tiruchirapalli to the south-west and Perambalur to the west [20].

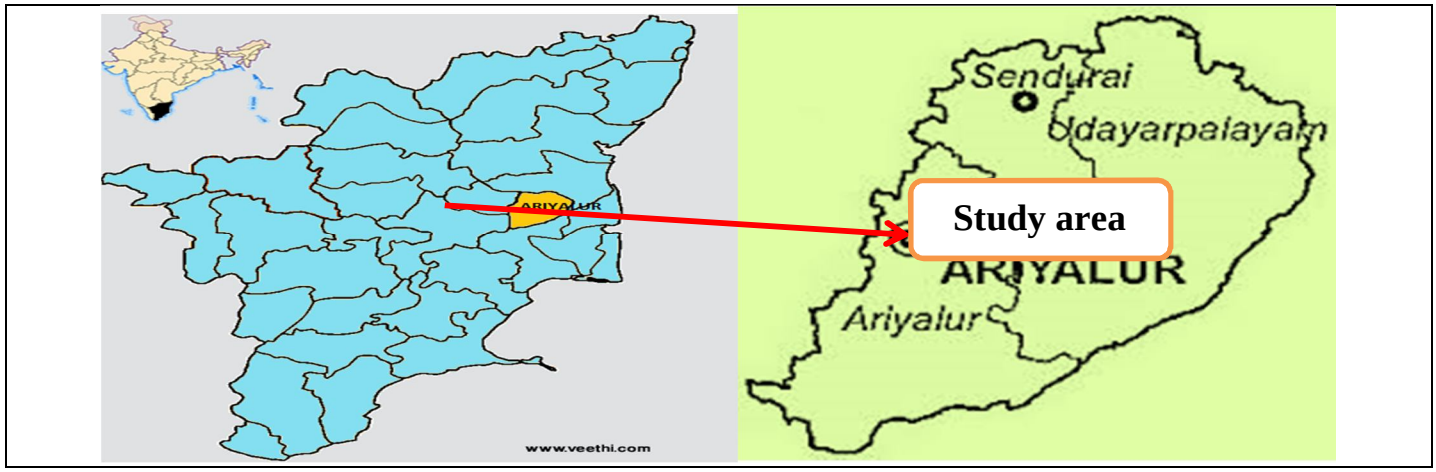


Fig 1: Geographical map of Studey area

The groundwater samples (Fig 1) were collected from ten different points near Cement industry areas of Ambur taluk, where many registered Cement industries discharge their vast amount of untreated waste straightly into the aquatic bodies. So this area was selected as a research area to compare the level of heavy metals contamination. Ten different points in the Cement industry locality were marked as SS-1, SS-2, SS-3, SS-4, SS-5, SS-6, SS-7, SS-8, SS-9 and SS-10 Which are located at 1000- 2000m distance from the disposal point of Cement industry areas in Ariyalur district.

A. Sample Collection and Processing

10 ground water samples were collected near cement industrial areas of Ariyalur district.



Fig 2: Collected groundwater samples in Ariyalur district

The sampling bottles were soaked with 10% HCl for 24 hours and then completely cleaned with demineralized water. Sampling bottles made of nice quality plastic bottles with 500 ml volume. The groundwater samples were stored at 4 - 6°C temperature prior to analysis in the lab (Fig 2). Samples were unfiltered and the concentration of the four heavy metals (Cr, Zn, Cu & Pb) could reciprocate to the entire concentration of the groundwater which were for agricultural, drinking and domestic purposes.to assess the quality of groundwater samples from bore wells and open wells during study period (May 2017 – Sep 2017). The analysed reports were discussed in accordance with the standards recommended under 'Indian standard drinking water specification BIS (Table 1).

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B. Total Heavy Metals Concentration Measurement

Cr, Pb, Cu and Zn metals were analyzed from groundwater samples by using Flame atomic absorption spectrometer (FAAS, (Sample volume – 10 mL/min. Burner – Air/Acetylene, N_2O/Acetylene burner/ Gases hallow cathode – Acetylene and nitrous oxide). These heavy metals were determined by spectrometric method using Flame Atomic Absorption Spectrometer - Model: PerkinElmer-AAnalyst. The results obtained were tabulated, evaluated and discussed in accordance with the standards prescribed under 'Indian standard drinking water specification IS 10500: 1991' of Bureau of Indian Standards (**Table .1)**.

III. RESULT AND DISCUSSION

Table 1: Heavy metal concentration in ground water samples collected near Cement industry areas in Sample areas of Ariyalur district

S.No	Heavy metals (mg/L)	BIS (IS 10500: 1991) (mg/L)	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	SS-8	SS-9	SS-10
1	Zinc	5 – 15	4.64	4.26	7.87	10.36	15.38	5.36	8.68	5.89	9.35	5.90
2	Chromium	0.05	0.062	0.025	0.085	0.097	0.052	0.084	0.095	0.091	0.060	0.055
3	Copper	0.05 - 1.5	1.70	2.26	1.42	3.35	2.26	2.64	1.54	1.84	1.28	2.40
4	Lead	0.01	0.240	0.065	0.087	0.362	0.105	0.086	0.064	0.055	0.185	0.120

Note- SS = Sample sites in the study area,

SS-1 = Govindapuram, SS-2 = Tjamaraikular, SS-3 = Keelpaluvur, SS-4= Alathiyur, SS-5= Reddipalayam, SS-6= Thalavai, SS-7 = Dalavoi, SS-8V= Sengamedu, SS-9=Nagalur, SS-10 = Poiyur

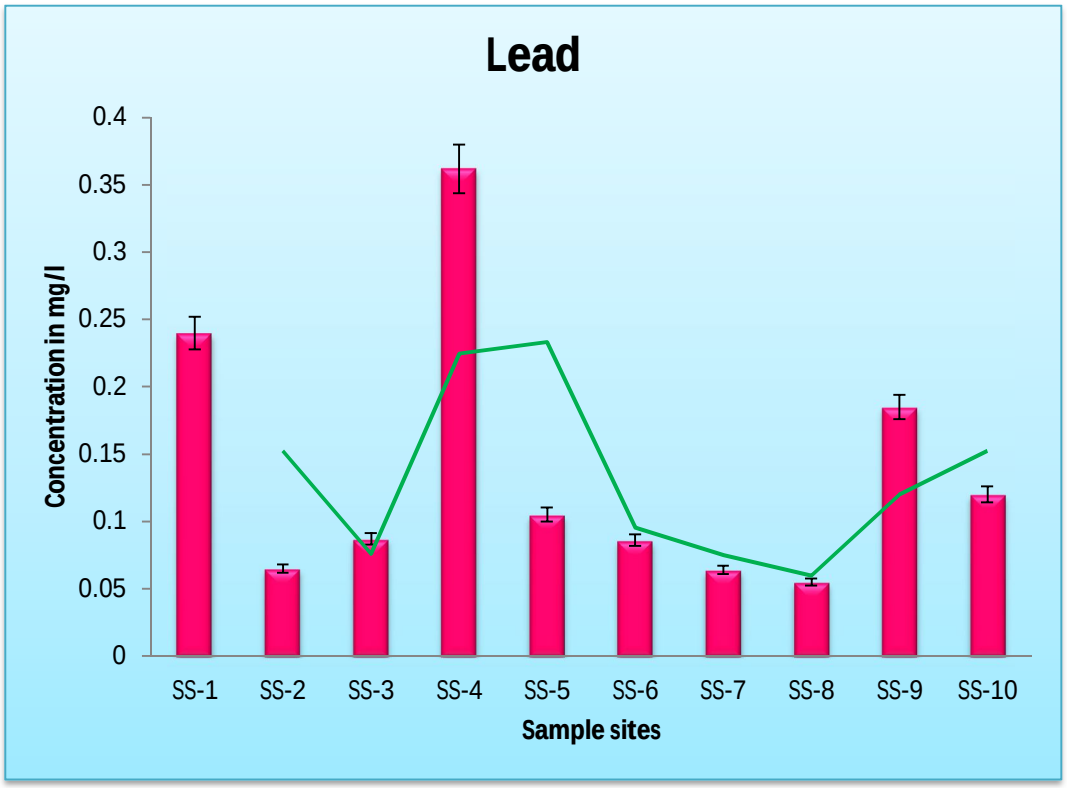


Fig 3. Concetration of Pb in groundwater samples in Ambur

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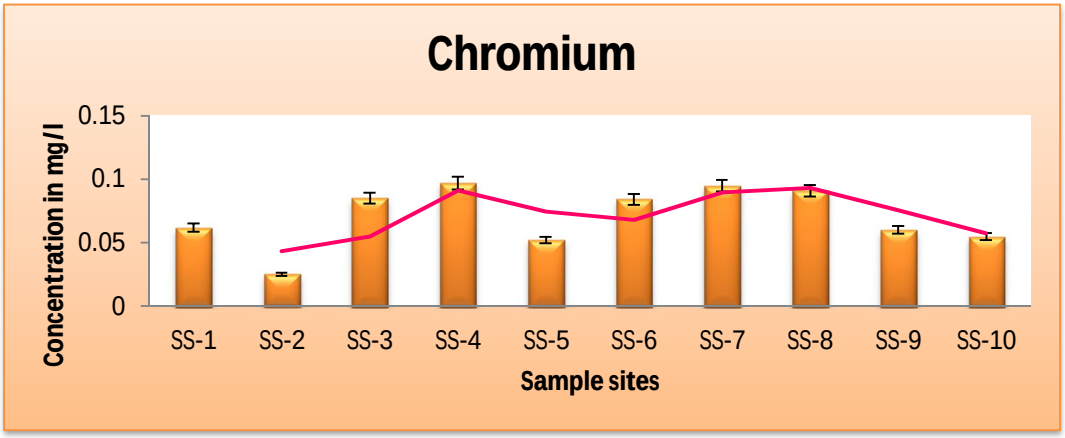


Fig 5. Concetration of Cr in groundwater samples in Ambu

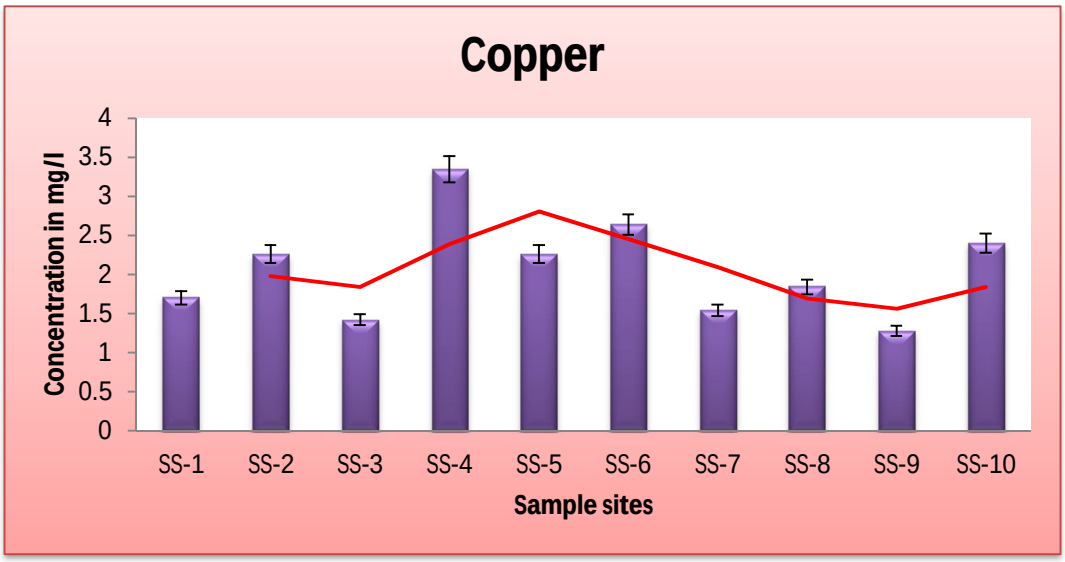


Fig 4. Concetration of Pb in groundwater samples in Ambur

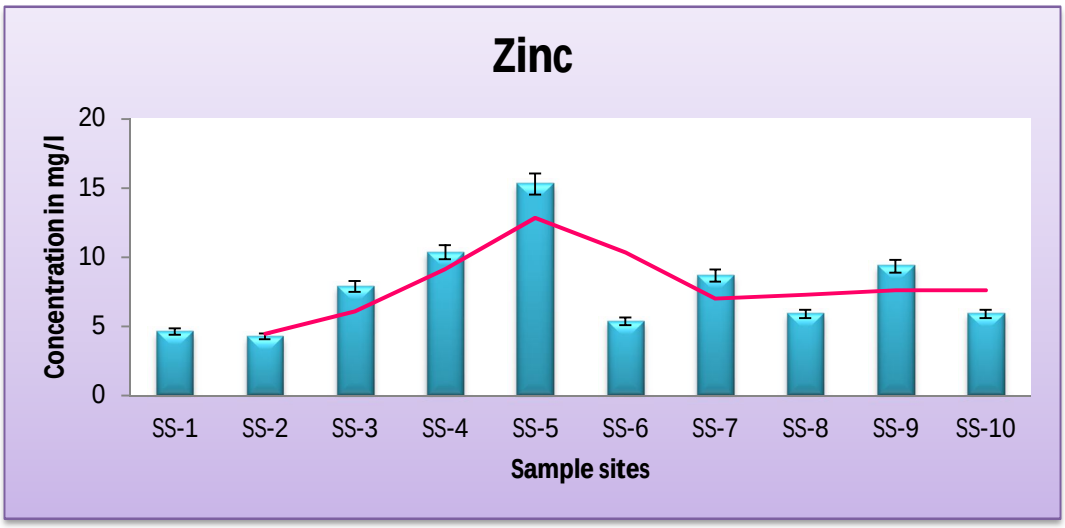


Fig 6. Concetration of Zn in groundwater samples in Ambur

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A. Chromium

We observed that concentration of chromium in ground water varied from 4.26 – 15.28 mg/l. The allowable range of chromium in consumption water is 0.05 mg/l according to bureau of Indian Standard (BIS). But the Chromium level in groundwater samples varied greatly in different sampling sites of study areas (**Table-3)**. The presence of amounts of chromium in ground water is associated with human health related problems.

B. Zinc

We detected in the study area, the concentration of Zinc in groundwater samples varied from 0.025 – 0.97 mg/l. The permissible limit of zinc is 5 - 15 mg/l. We observed that the higher zinc concentration in is (0.97 mg/l) in the study area. Zinc generally occurs in trace quantities in water but may attain not very many high levels in the collected groundwater samples. It can be toxic to certain concentration. In excessive limits, its causes to human health problems.

C. Copper

In this research area, we detected that concentration of Copper in ground water ranged from 1.28 – 3.35 mg/l. We found that the higher copper concentration in alankuppam (3.35 mg/l). The permissible limit of copper is 1.5 mg. the most of samples exceed the permissible limit (Table.1). Copper generally occur in trace quantities in surface water but may attain high levels in some ground waters. It can be toxic to certain aquatic organism even at concentration of 4 mg/l

D. Lead

In this research area, estimated that concentration of Lead in groundwater samples ranged from 0.055 – 0.362 mg/l. The permissible limit of lead in drinking water 0.01 mg/l according to bureau of Indian Standard (BIS). After this survey, it was cleared that Pb contamination of soils in the locality of Cement industry is honestly high in all ten Cement industry location samples and observed that Pb was exceeded the permissible limits (Table. 1).

IV. CONCLUSION

Heavy Metal contamination in soil has now become a most important concern. In growing countries like India, the condition is worst due to lacking of technological improvement. From this revise, it is obviously the evident that the groundwater samples in the Cement industry locality of Ariyalur district, the collected groundwater samples in the study area of Ariyalur district is not exceedingly contaminated only slightly contaminated with Cr , Pb, Cu and Zinc. This is due to being exposed to an enormous amount of raw Cement industry wastes from the nearby cement industry day by day. A considerable quantity of Copper(Cu), Zinc (Zn) and Lead (Pb) has also been found in the soil of this area which were not exceedingly contaminated but very slightly contaminated in only few sampling points of this study area. These metals might accumulate and deposited in soil and uptake by vegetables and fruits through route of plants and other crop grown in this area which eventually gets into animal and human body through the tropical food chain. This results in dissimilar unpleasant effects on animal and human health as Cr, Pb, Zn and Cu are extremely toxic and carcinogenic in environment. So authority concerned need to take immediate measures for these problems to prevent such infectivity by these heavy metals.

A. Remedy

In order to beat the above problems, heavy metal can be suppressed from effluents and waste of Cement industries and other industries, some low cost adsorbent can be recommended such as coconut shell carbon, rice husk carbon, fly-ash, charcoal etc. before discharging waste into surface water body these adsorbent must be used which would be very useful to suppress metal contamination.

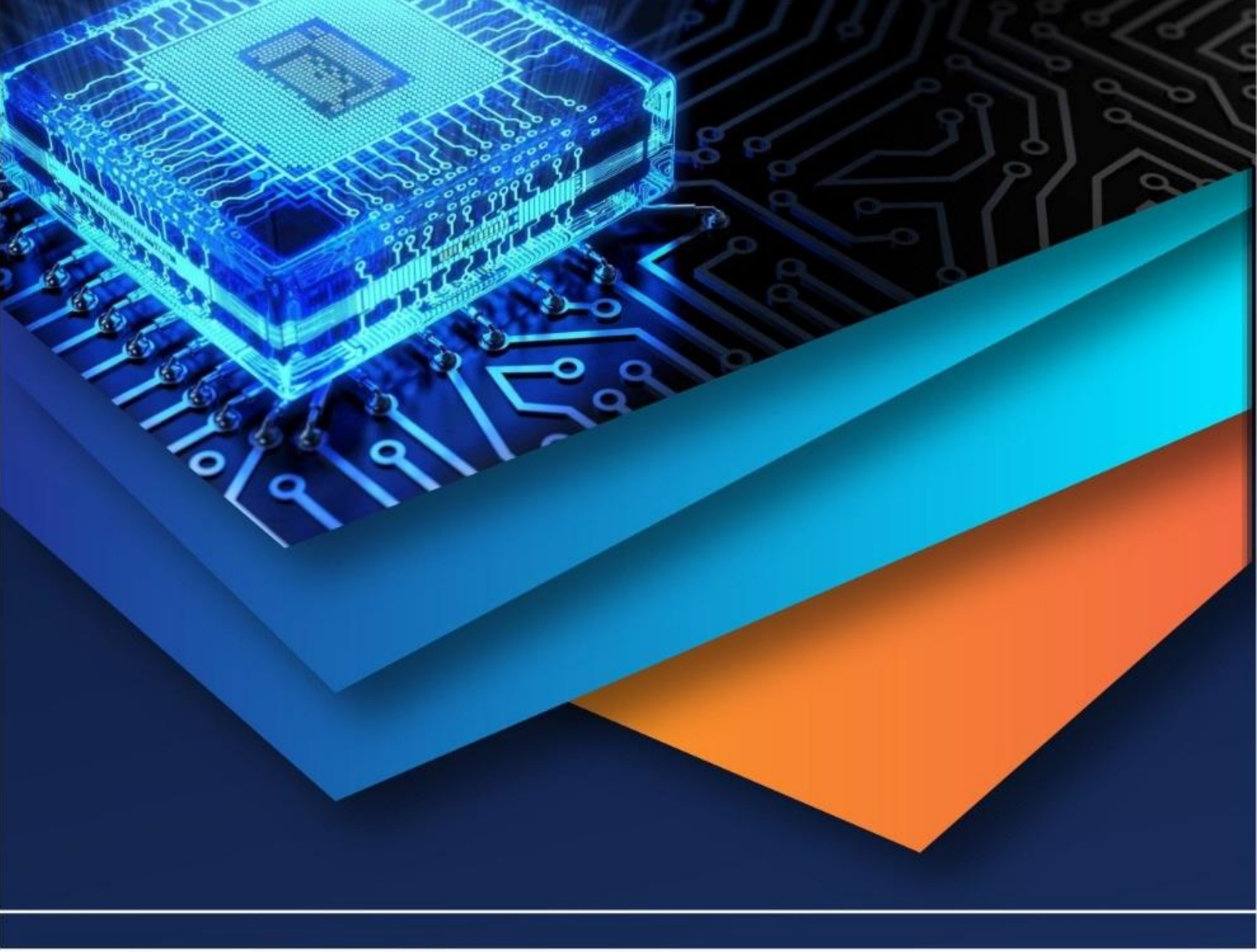
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