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Assessment of Ground Water Quality of Greater Guwahati With Reference To Iron and Fluoride

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Abstract: ***Safe drinking water has become an emotive issue in Assam, primarily with fluoride, arsenic and iron contamination. Unfortunately, fluoride contamination is a very recent issue that has been observed in various districts of Assam. This study intends to assess the ground water scenario of greater Guwahati and identify the iron and fluoride affected areas. Eight different locations have been selected within the city and the sources were mainly boring deep tube wells, ring wells and tube well. The investigation reveals that iron and fluoride are the points of concern in the areas considered for the study. The concentration of iron was found to be high in almost all the locations, maximum being 8.59mg/l, reflecting the water quality to be unsafe for drinking directly from the source. Moreover, in case of fluoride, out of eight monitoring sites, two locations namely 'Satgaon' and 'Hatigaon' were observed to be crossing the permissible limits of 1.5mg/l, with 2mg/l and 1.6mg/l respectively. The other water quality parameters like pH, conductivity, alkalinity, chloride, total hardness, calcium, magnesium and nitrate were found to be within the permissible limit.***

Keywords: Ground water quality; Iron; Fluoride; Greater Guwahati; Drinking water.

I. INTRODUCTION

Groundwater is the water found below the earth surface in the rock cracks and spaces between soil, sand and rock. Groundwater contamination is nowadays a common issue. Groundwater naturally consists of few chemical components which are derived from the rocks below. However, sometimes the concentration of these elements may rise, as a result of which the water becomes unsuitable for drinking purpose. The groundwater quality has been of alarming concern in all the developing cities including Guwahati, which is no exception in this regard[1,2]. The quality of groundwater is in serious danger due to the presence of harmful elements such as fluoride, arsenic, chloride etc. [3,4]. Several cases of dental and skeletal fluorosis have been detected among the children in the State. The quality of groundwater in some areas of Guwahati has declined, forcing people to either change their water source or follow remedial measures in order to use the contaminated water. In most cases, fluoride found in groundwater occurs naturally due to the breakdown of rocks or weathering and deposition of atmospheric volcanic particles. The fluoride is derived from minerals found in the Precambrian granite rocks which acts as the basement for the city and also outcrops all around the city [5,6].The city of Guwahati, even though is located on the bank of the mighty Brahmaputra, depends mainly on the groundwater resource for the water requirements. At present, the water supply facilities in Guwahati Metropolitan area are operated by three departments, viz., Guwahati Municipal Corporation (GMC), Assam Urban Water Supply and Sewerage Board (AUWSSB) and Public Health Engineering Department (PHED). The existing systems cater to about 30% of the residents. Besides of the water supply system, the households are mainly using the groundwater and the water supplied through the tankers [1]. The presence of Iron in ground water is due to its natural existence in the underground rock formations and precipitate water that seeps down through it. Moreover, sometimes, the iron content is found to be more in water pumped from hand tube wells. Also, its content may be high if Iron salts are used as coagulating agents in water-treatment plants and where cast iron, steel and galvanized iron pipes is used for water distribution purpose. So this paper intends to study the ground water quality of Guwahati city and propose cost effective remedial measures among the people.

II. AREA OF STUDY

Guwahati is commonly known as the "Gateway to the Northeast" the largest city of Assam a major riverine port city and one of the fastest growing cities in India, situated in the South Bank of river Brahmaputra. With an area of 1,528 square kilometers (590 sq. mi), Guwahati is the second-largest metropolitan region in eastern India, after Kolkata.

A. Geology of Guwahati

The rock types found in the hilly regions of Guwahati can be classified as:

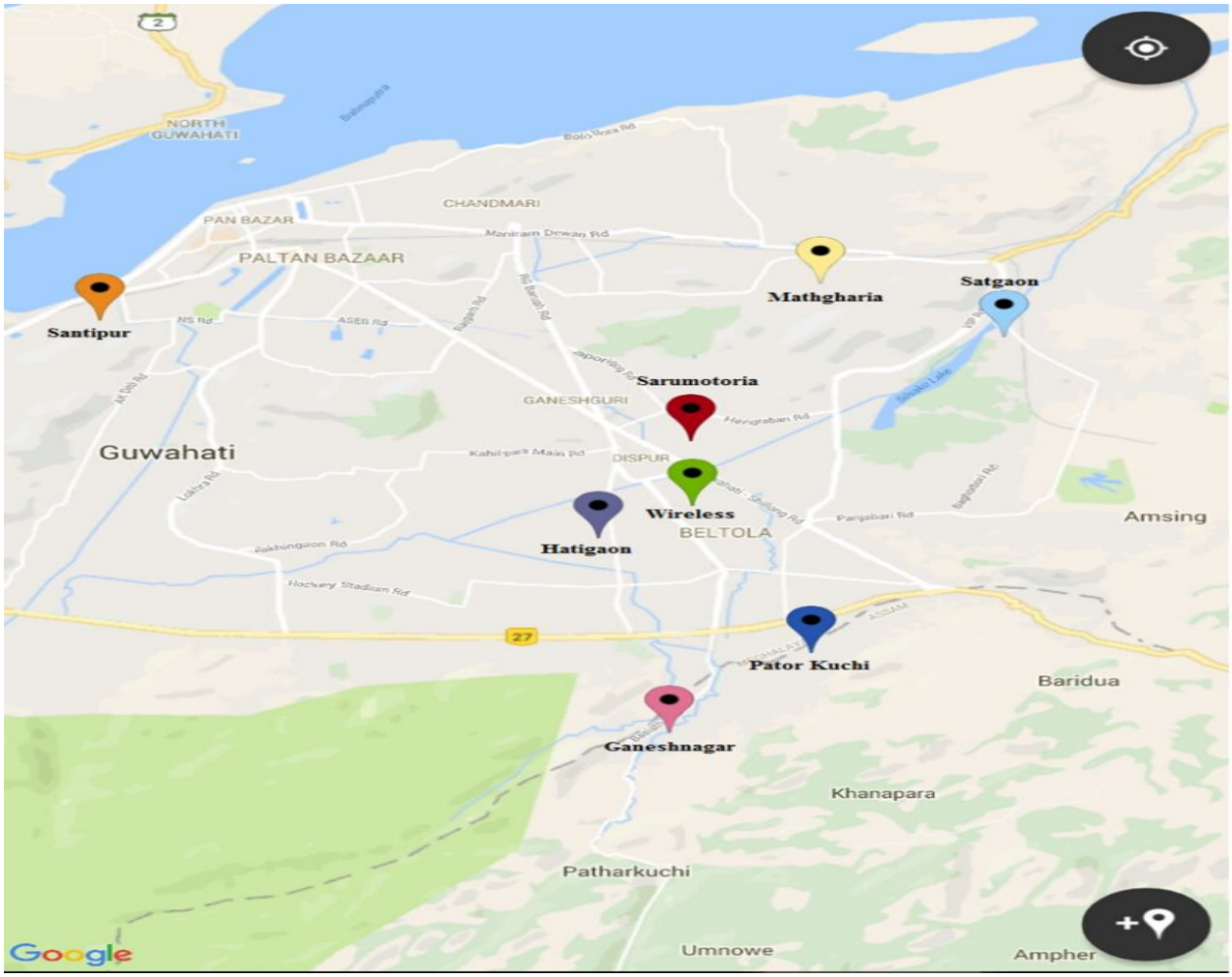
1) Granite Gneiss
2) Granite
3) Porphyritic Granite
4) Quartzite
5) Pink Granite
6) Hornblende - Biotite - Schist,
7) Pegmatite and Quartz (in the quartz-veins)

Rocky protrusions are few and are mainly confined to the hilly sides, the intervening areas are mostly covered by alluvial soil and residual soil. The hills are generally covered with the red soil. Rock exposures are mainly found in hilly streams which appear to be'in situ'. It is generally found insome places that rocks are highly weathered and soil formation is continuing [7].It has also been reported that the weathering of primary rocks and leaching of fluoride-containing minerals in soils yield fluoride rich groundwater in India and is generally associated with low calcium content and high bicarbonate ions. [8]

To identify the Iron and Fluoride affected areas of the city, ground water samples were collected from eight locations of city that is from Ganeshnagar, Patarkuchi, Hatigaon, Wireless, Satgaon, Mathgharia, Santipur, Sorumataria. Samples were collected in May and June months of 2016. At least 5 samples were collected from each site.The topographical nature of the selected locations varies from hilly to plain area. The locations Patarkuchi, Ganesh Nagar, Satgaon and Santipur are located in a hilly area and Mathgharia and Sorumotoria are located in a semi hilly area while Hatigaon and Wireless are situated in plain area.

Table I. Sampling Sites at Guwahati, Assam

Sl. No	Location	Date & time	Coordinate	Groundwater source
1.	Patarkuchi	29/5/2016 11:40 A.M	26°06'29.5" N 91°48'24.4" E	Ring well (20 feet)
2.	Ganesh Nagar	29/5/2016 12:20 A.M	26°05'28.9" N 91°47'37.1" E	Ring well (25 feet)
3.	Hatigaon	29/5/2016 10:23 A.M	26°07'55.6" N 91° 47'12.8" E	Boring deep tube well (350 feet)
4.	Wireless	30/5/2016 08:54 A.M	26°08'01.9" N 91°47'35.5" E	Boring (150 feet)
5.	Satgaon	1/6/2016 11:22 A.M	26°09'43.4" N 91°50'01.9" E	Boring (120 feet)
6.	Mathgharia	1/6/2016 10:52 A.M	26°10'56.6" N 91°48'38.4" E	Ring well (35 feet)
7.	Santipur	1/6/2016 12:32 P.M	26°10'08.4" N 91°43'48.0" E	Tubewell (20 feet)
8.	Sorumotoria	1/6/2016 10:02 A.M	26°08'39.1" N 91°47'41.4" E	Tubewell (50 feet)



(Source: Google Map)

Figure1. Sampling sites at Guwahati, Assam

III. METHODOLOGY

Eight different locations considering their distinctive topographic nature within the city were selected for the study. The two liters' sample was collected from each site in polypropylene bottles. The samples were collected from the source in such a way that there is minimum air gap between the sampling bottle and the source of the water. In case of ring wells, the water drawing bucket is dipped deep into the well and water is drawn from the lower part of the well. In case of tube wells, the water was pumped out for some time and then the water is collected by holding the head of the bottle as near as possible to the tube well mouth.

Table II. Methodology applied

Sl. No.	Parameter	Methods
1	Iron	Phenanthroline method
2	Fluoride	Ion Selective method
3	pH	Electrometric method
4	TDS	Gravimetric method
5	Chloride	Argentometric method

6	Alkalinity	Titrimetric method
7	Total hardness	Titrimetric method
8	Calcium & Magnesium	Titrimetric method
9	Nitrate	UVSpectrophotometric Screening method

The methodology used for analysis of water quality parameters wasas per APHA,1995 [9]and the parameters were compared to the acceptable and permissible limit set by BIS [10].

IV. RESULTS AND DISCUSSION

The ground water collected from the selected locations was subjected to physico chemical analysis as mentioned above in table 2. The pH value was found within the prescribed limits of BIS limits i.e., 6.5-8.5 (Table 3). The concentration of pH, TDS, Chloride and Nitrate is within the permitted limits, whereas, Calcium, Magnesium, Alkalinity and Hardness is higher than its limits[11]. The samples were collected from ring wells, hand tube wells and boring. The water collected in Ganeshnagar was from ring well (20 ft.), Patarkuchi was from ring well (25 ft.), Hatigaon from boring deep tube well (350 ft.), Wireless from boring (150 ft.), Satgaon from boring (120 ft.), Mathgharia from ring well (35 ft.), Santipur from tube well (20 ft.), Sorumotoria from tube well (50 ft.) After the analysis of the samples, it is observed that in all the selected locations except Ganeshnagar, the level of Iron was found to be exceeding the permissible limits as set by the Bureau of Indian Standards. Regarding Fluoride, only two locations exceeded the permissible limits. The other parameters of all the locations were found to be within limits.has Study has been done on the Fluoride mitigation strategies in India, which can reduce the impacts of fluoride in human being [12]. The availability of fluoride in the selected locations is dependent on the depth of the source and the geological features of the area. Fluoride is mostly found in rocks which occur in hilly areas. According to the analysis done, fluoride was found in Hatigaon (plain area). The water was drawn from a 350 feet deep tube well. At such depth, underground rocks are present which acts a source of fluoride in the groundwater in that location. Secondly, fluoride was found in Satgaon (hilly area). The water was drawn from a 120 feet boring well. Since it is a hilly area, the source was only dug few feet. The rocky feature of the location acts as a source of fluoride in groundwater. Similarly, reports about the Arsenic contamination in Manipur, North- Eastern hills and it is due to sediments derived from the Himalaya and surrounding mountains and has no relation with the depth [13].

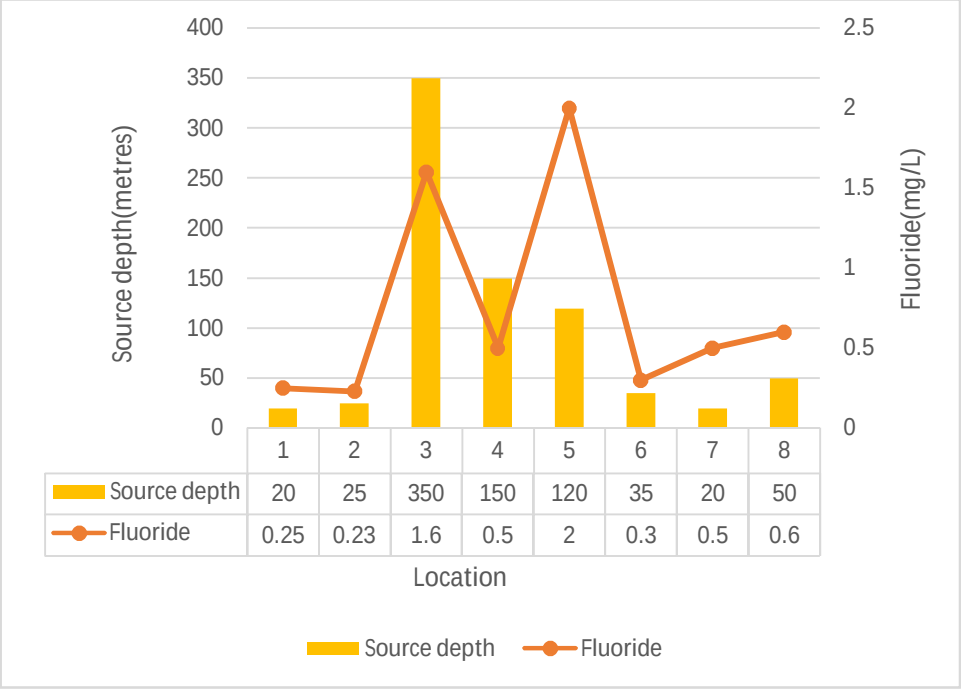


Figure 2: Relationship between the fluoride levels and the source depth.

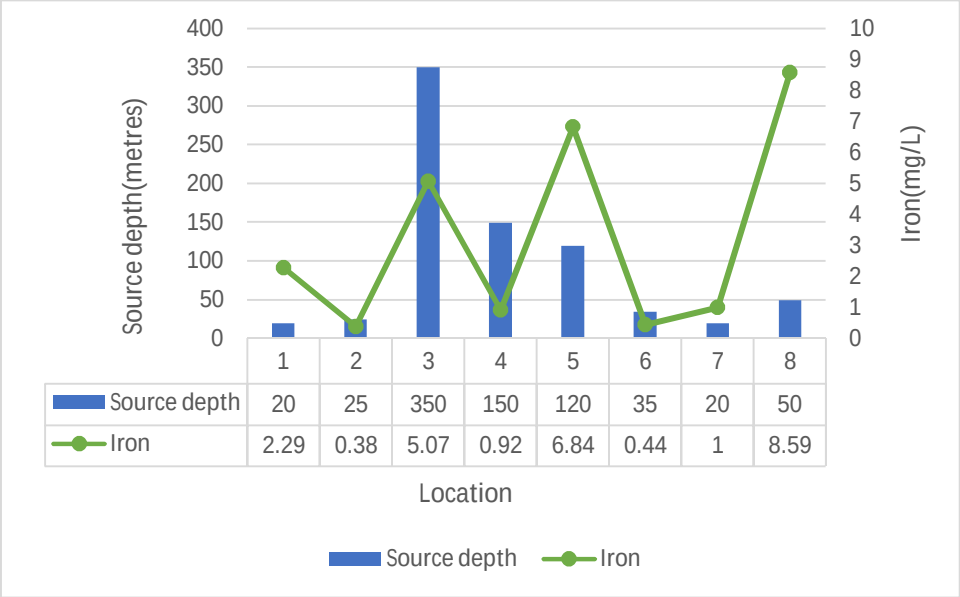


Figure 3. Relationship between the iron levels and the source depth.

The analysis report shows the concentration of iron to be exceeding the limit, 0.3mg/l as laid by BIS- Drinking Water Specification- 2nd Revision IS 10500: 2012. Iron was found in the range of 0.38 – 8.59 mg/l clearly reflecting the water to be unsuitable for drinking directly from the source.

The minimum Iron concentration in the investigated areas was found to be 0.32mg/l which is marked to be in the border line. However, the rest of the seven locations were observed with high concentration of Iron. Hence restriction should be implied on those areas not to consume the water directly from the source. The amount of fluoride in two locations i.e. location 3 (Hatigaon) and location 5 (Satgaon) are 1.6 ppm and 2 ppm respectively which exceed the limit according to the drinking water specification. The analysis reveals that iron and fluoride are matter of concern in the studied areas. In two cases, fluoride was found above the permissible limit which is a matter of concern for the people of that place. Suggestion implies to those affected areas to discontinue drinking from that source. Several research and work are still in the process to develop cost effective technique for the removal of fluoride concentration. It is seen, in almost all the investigated locations, water collected directly from the source has high concentration of iron. Similar results were observed in case of iron concentration in ground water samples at Brahmaputra river basin in Golaghat (Assam), India [14].

Table III. Quantification of the parameter tests done on theground water samples.

	pH	TDS	Chloride	Total alkalinity	Total hardness	Ca	Mg	Nitrate	Iron	Fluoride
BIS Standards acceptable limit	6.5-8.5	500 mg/L	250 mg/L	200 mg/L	200 mg/L	75 mg/L	30 mg/L	45 mg/L	0.3 mg/L	1.0mg/L
BIS Standards permissible limit	-	2000 mg/L	1000 mg/L	600 mg/L	600 mg/L	200 mg/L	100 mg/L	-	-	1.5 mg/L
SAMPLING SITES										
PatorKuchi	6.5	302	86	216	206	144	62	2.6	2.29	0.25
Ganeshnagar	6.5	98	22	80	70	52	18	3.3	0.38	0.23
Hatigaon	7.1	14	10	210	106	74	32	0.4	5.07	1.6
Wireless	7.3	212	16	258	158	108	50	BDL	0.92	0.5

Satgaon	6.8	184	6	242	90	62	22	1.3	6.84	2
Mathgharia	6.7	546	134	328	284	182	92	9.2	0.44	0.3
Santipur	6.8	128	8	168	160	116	44	0.1	1.00	0.5
Sorumataria	6.2	224	58	180	188	138	50	0.1	8.59	0.6

V. CONCLUSION

So, the ground water samples collected from eight different location Guwahati city were subjected to few physico chemical analysis tests, and it can be concluded that the parameters: pH, TDS, chloride, total alkalinity, total hardness, magnesium, calcium, nitrate are within the acceptable limit as mentioned in the BIS 10500:2012. However, iron concentration is observed to be exceeding the limit 0.3 mg/L in all the locations and ground water samples from two locations, namely Hatigaon and Satgaon have fluoride concentration more than the permissible limit and acceptable limit i.e. 1.5 mg/L and 1.0 mg/L respectively. So, it is advisable that the ground water of these locations should be treated before usage since it can affect the health adversely in the long run if consumed on a regular basis.

For iron, low maintenance initiatives can be taken to adopt sand filter before using the water for domestic usage. Boiling the water before consuming is suggested to get rid of iron to some extent, besides using expensive RO system. Certain methods such as reverse osmosis, ion exchange, or distillation systems can be adopted for fluoride removal. A research study is going on the use of neem charcoal, which is used to filter the water rich in fluoride.

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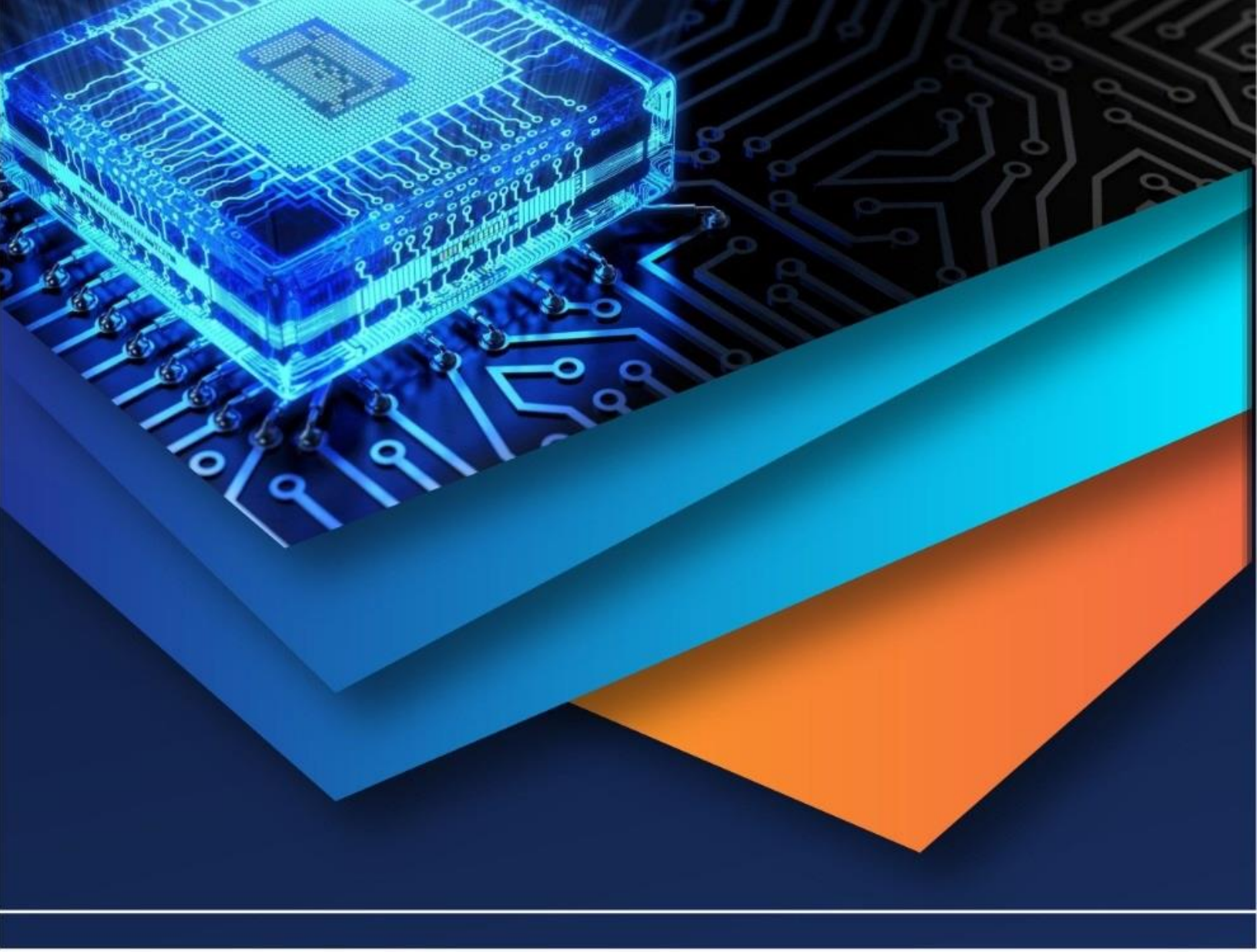

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