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Waste Recycling: Utilization of Kitchen (Canteen) Waste and Garden Waste in Vermicomposting

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Abstract: ***This study was implemented to investigate the effect of using garden waste, canteen waste with the addition paper in vermicomposting with regard to temperature, loss of weight, fluctuation of total and available content of nutrients and viability of earthworms. Canteen, garden and paper bio-waste must be pre-composted for more than 2 weeks to reach a temperature below 25 _C. Vermicomposting increased the total content present in the vermicompost like N, P, K, Ca and Mg. Addition of used paper into kitchen bio-waste proved to be a suitable feed for earthworms. On the basis of the obtained data, a new type of vermicomposting for separated pre-composting and subsequent vermicomposting of food waste has been developed. And the final product produce from the vermicomposting is vermicompost with high nutrient quantity, which is useful for the plant growth.***

Keywords: Vermicomposting, Technology, canteen waste, Nutrients, Earthworms

I. INTRODUCTION

Globally, roughly one-third of the food produced for human consumption is lost or wasted, which amounts to about 1.3 billion tons per year [4]. Large quantities of organic wastes are produced from agricultural production and farming systems, including animal manures sewage bio-solids, food and restaurant wastes, and industrial organic wastes. These have the potential of increasing global soil and water pollution, because they are currently disposed of by land-spreading, incineration, or into landfills [3]. As much as 50%–60% of the total wastes that are disposed into landfills are organic wastes. Vermicomposting increased the total content of P, K, Ca and Mg and the availability of P and K.and which is useful for the plant growth [1].

Aristotle was ahead of our times by two and half of millennia. It defines the exact potential for waste reduction, fertilizer production, as well as solid waste management of possible uses for the future. Vermicomposting is the process of producing organic fertilizer or the vermicompost from bio-degradable materials by using species of earthworms. Composting with worms avoids the needless disposal of vegetative food wastes and enjoys the benefits of high quality compost [10]. The worms are capable to convert waste into the superior quality of the fertilizer. They break down organic matter and convert organic matter into the vermicast having the good quality of manure, and this manure used as a soil fertilizer. Now a day the waste disposal of organic waste is an important point to reduce the cost of the waste disposal have escalated and environmental regulation and their disposal have become restrictive, the vermicomposting in which garden waste, kitchen waste with addition of cow dung are composted by using earthworms, and the composted waste used as soil conditioner or fertilizer, Vermiculture and Vermicomposting [15]. The basic principle of vermicomposting is an alternative to thermophilic composting is use certain epigic species of earthworms to break down organic wastes and converted into vermicompost that can be used for the agriculture for soil improvement as bedding media. Many of the organic wastes produced by agriculture, farms, and modern industrial technology cause odor problems or can result in the pollution of groundwater. Early research in the Rothamsted program suggested that these problems could be alleviated by the use of earthworms, particularly Eisenia fetida (Savigny) and other epigeic species such as Eisenia andrei (Bouché), Dendrobaena veneta (Rosa), Eudrilus eugeniae (Kinberg), and Perionyx excavatus (Perrier), to accelerate the aerobic decomposition of organic wastes, thereby minimizing odors and pollution and producing a considerable potential profit from the sale of earthworms and also of the vermicompost for use as a plant growth medium. The vermicomposting process completed in 49 days or up to the 6 month below 25 _C[21].the moisture content for vermicopost is 80%. Some popular composting Methods are:

A. Open system

1) In which this system is adopted for composting of municipal solid waste due to simple operation as the name implies, the feedstock is mixed periodically using a front-end loader or similar equipment.
2) Turned windrows are elongated compost piles that are turned frequently to maintain aerobic conditions. Forming windrows of the appropriate size helps there are different methods for composting in which the waste is pre-composted for 2weeks and then is composted. in maintaining the desired temperature and oxygen levels.

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3) Static piles using air blowing or suction can also be used. This approach is effective when space is limited and the composting process must be completed relatively rapidly. In this method, a series of perforated pipes is situated within or below a pile (or windrow). Air can be supplied via a negative pressure (suction) system or a positive pressure (blower) System. Fans or blowers force air through the pipes, which is then drawn through the feedstock materials. The air movement through the pipes maintains aeration within the pile, thus eliminating the need for turning.

B. Closed System

1) Rotating drums rely on a tumbling action to mix continuously feedstock materials.

2) Tanks are available as horizontal or vertical types. These tanks are long vessels in which aeration is accomplished through the use of external pumps that force air through the perforated bottom of the tanks.

The vermicomposting systems are designed and operated to establish optimum conditions for vermicomposting. These conditions directly related to the growth and metabolism of the microorganisms that are responsible for the process. This process includes the bio-oxidation and stabilization of organic material by the action of earthworms and microorganisms. The vermicomposting include the five phases in which first involves the collection of waste. Phase two include pre digestion of organic waste for 21days, in phase 3 preparation of earthworms bed. Collection of earthworms after vermicompost. After that the earthworms and compost separated in the simplest mechanical devices in which separate wastes on trammels with reciprocating or rotating sieves that retain the earthworms but allow smaller particles of vermicompost to pass through the meshes; others employ comb like structures through which the earthworm-worked material passes, selecting earthworms, which are hooked on the combs and drop onto a moving belt. And the vermicompost is used for soil conditioner or fertilizer.

II. MATERIALS AND METHOD

A. Collection of bio-waste

The waste used in this experiment was kitchen bio-waste collected in canteen from JIT institute and garden waste collected from the institute.cow dung collected from the near cow shed. A detailed description of the composition and properties of this canteen bio-waste is shown in our previous study [17]. The composition in terms of weighted and volumetric fraction is shown in Table 1. Shows the different types of waste used for the vermicomposting Treatment of bio-waste by pre-composting before vermicomposting, part of the canteen bio-waste with garden waste and with old paper was pre-composted in vermireactor.

TABLE NO.1
Different Types Of Waste

Component	Weight in Kg
Garden waste	55
Canteen waste	50
Paper waste	10
Cow dung	65

The vermibed were kept in a room at 25 _C for 14 days. This vermibed containing windows for the aeration. Vermicomposting For vermicomposting, a specially adapted shaded area with controlled conditions (temperature 22 _C, relative humidity 80 %, ventilation) was used. The size of the plastic vermibed12X8X4 m having six aerated windows, eleven supported pipe and one outlet to collect the leachate from vermibed. After the pre-composting the waste collected in vermibed for the vermicomposting with the addition of the 1800 no's earthworm (Eisenia fetida) and 65kg of cow dung added for earthworms feeding. Daily water spread over the vermibed to maintain moisture content for vermicomposting.

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Fig No.1- Site of vermicomposting(JIT,COE)

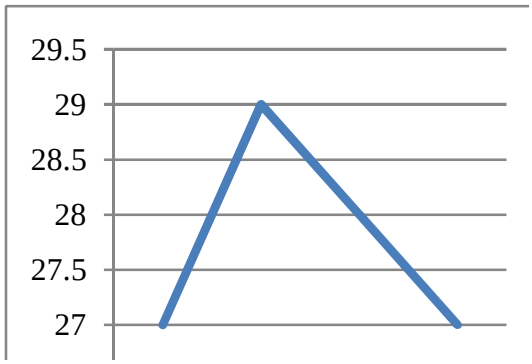
After the composting period the moisture content ,pH ,Electric conductivity, temperature P,K,Ca,Mg find out. The test carried out by using oven, pH meter, and electric conductivity meter temperature directly measure by using thermometer and nutrients find out by using photo-flame meter. Each treatment was carried out in triplication. Site selected for vermicomposting near to the jawahar education society and the waste collected from the jawahar education society like garden trimmed waste which is passing through the 25mm diameter. Canteen waste collected from the canteen waste in which waste food and waste water collected, and paper waste. Before sampling, the eventual leachate captured in a stainless bowl was returned to the vermicomposted material to achieve a closed loop. A sample of 200 g from every bowl was collected every month for 45,55,65,75 days. The earthworms were then sorted out and the resulting samples were dried at laboratory temperature and ground.

B. Analytical Methods

Measurements of pH were taken from samples. pH measure by using digital pH meter.). Temperature measure by using thermometer and electric conductivity measure by using conductivity meter. Moisture content measure by using oven dry method. And remaining parameters .After the 45 days the experimental work started.

III.RESULT AND DISCUSSION

Treatment of feedstock by pre-composting Graph 1 illustrates that the maximum temperature of 29 _C was recorded in 45, 55, 65 and 75 days. From the 55 day, there was a gradual decrease in temperature, until 27 _C was finally reached after 75 days of the process. Mixtures of canteen waste with paper waste reached slightly higher temperatures compared to canteen waste with paper.



Graph No-1No.of days verses Temperature

This Graph Shows the Temperature For the vermicomposting. The temperature required for the vermicomposting is 19-30 degree Celsius. If the temperature greater than the 35_c then the earthworms are killed. So the temperature is maintained with the help of shed or covering dead leaf over the vermibed. The graph shows the temperature is between 27-29_c.so then there is maintained temperature. For serial of the earthworms the temperature required 19-30_c. There may be differences in vermicomposting method depending on the climate.

Measurements of pH were taken from frame the pH meter directly. The other parameter nitrite, potassium, calcium, magnesium, phosphate measured by using photo-flame meter and spectrophotometer. From the Results obtain from the vermicomposting are given below and this result analyse with the help of literature .In which first pH calculated by using digital pH meter.

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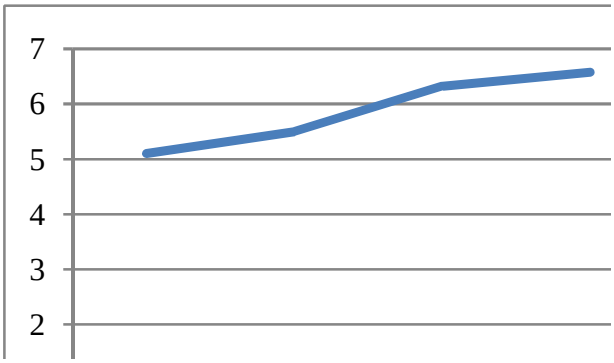
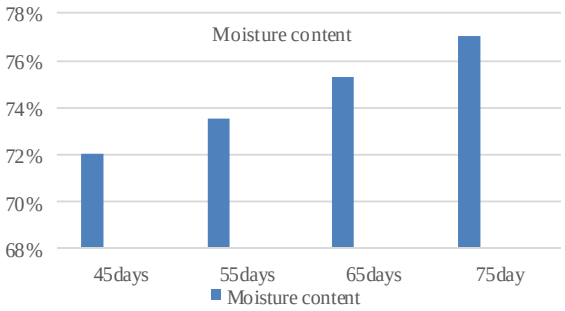


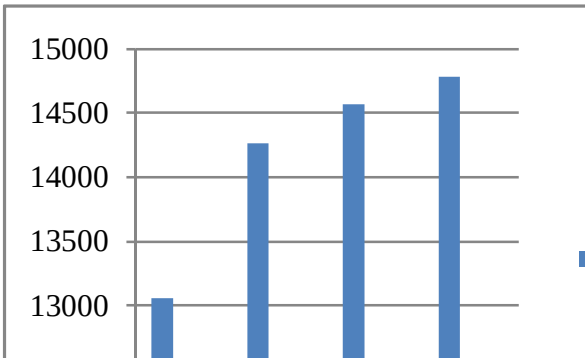
Graph No.2:No. of day's verses pH

The graph shows the pH and composting days are directly proportional. The no of composting days increases with increase in pH Soil pH is a measure of the acidity and alkalinity in soils. pH scale range from 0 to 14, with 7 becomes neutral, below 7 acidic and above 7 alkaline. The optimal pH range for most of the plants is between 5.5 and 7.5. In vermicomposting moisture should be maintained above 50%, as lower moisture content will not help to the worm respiration and can increase worm mortality. Operating moisture-content for the vermicomposting range should be between 70-90%, with a reference content of 70-80% for vermicomposting-oriented vermiculture operations. If decomposition has become aerobic. For maintaining of moisture content the daily water spread over the vermibed with the help of nozzle. And the moisture content in vermicast measure by using oven.



Graph No.3:No.of days verses Moisture content

The above graph shows the moisture content in the vermicopmosting. The moisture content in the vermicomposting 70-80%.the moisture content in sample is measure by the oven. The moisture content in the sample is measure 45, 55, 65, and 75 days respectively. From the above literature survey the moisture content in the vermicomposting should be 70-80%. Potassium is an essential for the plant nutrient and is necessary in large amounts for proper growth and multiplication of plants. Plants absorb potassium in its ionic form, K+from the potassium. The graph shows the increase in potassium content in the vermicomposting the no. of days increase with increase potassium .for the growth of the plant potassium required 10000-20000Mg/lit.



Graph No.4:No.of Days verses K

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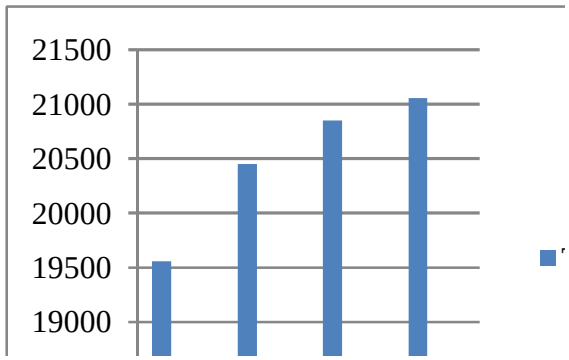
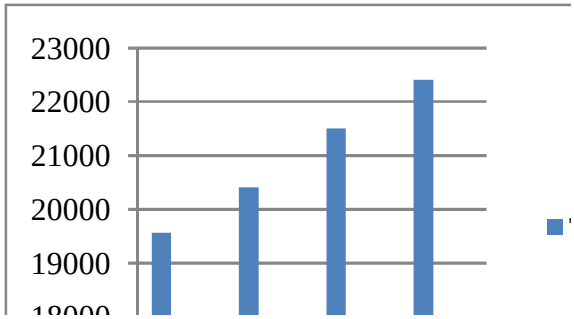
The total K content of soils need 20,000 ppm (parts per million). While the supply of total K in soils is quite large, relatively small amounts are available for plant growth at any one time.
So the vermicast is useful for the plant growth in this way we can utilize the solid waste in the form of vermicast.



Graph No.5:No.of Days verses Total mg

Magnesium (Mg) is an essential for the plant nutrient. Magnesium are a common nutrients in many minerals, comprising 2% of the Earth's mineral. Magnesium is also a common component in seawater (1,300 ppm). Most research has shown that a soil test reading of 40 to 50 ppm (18000-21000mg/kg) of magnesium is adequate for crop production.
The canteen waste increases the magnesium and calcium contain in vermicomposting. After the result find out the magnesium and calcium increases with addition of canteen waste and paper waste.



Graph No.6: No.of days verses Total Ca

Calcium as a plant nutrient is characterized by its relatively high content in the plant coupled with a requirement not much higher than that of a micronutrient element and an exceedingly uneven occurrence in soils.
After the result obtained from the vermicomsting this data analyse with respect to the literature survey . Given that the optimum temperature for the proper development of earthworms should not exceed 25 C, canteen waste garden waste cow dung mixed with paper pieces should be pre-composted for more than 2 weeks [5]. For pre-composted material, it is assumed that the temperature will no longer increase during vermicomposting and that this important condition for successful vermicomposting will have already been met. So, the properly pre-composted material could be put into an aerated vermibed in a large volume at once without danger of heating [8]. In a study investigating the influence of temperature on pathogen content in canteen waste it was found that the optimum period to obtain pathogen safety was 9 days of pre-composting, followed by 2.5 months of vermicomposting. This result showed that if pre-composting process did not reach a high enough temperature, it was possible not only that pathogens may be insufficiently inactivated, but also that they would even proliferate [4]. In vermicomposting, earthworms mineralize the organic matter, converting a part of it into worm biomass and respiratory products, while the rest is egested as nutrient rich vermicompost. The appropriate feed composition for the earthworms could optimize the value of the vermicompost which is apparently more available for plants [5]. Lower contents of N-NO3- in pre-composted materials than in raw materials at the end of vermicomposting could be partially explained by higher pH levels in the first mentioned materials [20]. Higher total contents of macro elements in final vermicompost compared to feedstock was affected by changes of weight and material volume during the process. In addition, part of the element amounts had to be accumulated in earthworms. The uptake of elements by earthworms and their accumulation in the worms' tissues is affected by earthworm density and quality of feed. At the end of the study, the earthworms were sorted out

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from the analysed sample [12]. Thus the change of earthworm biomass affected the total and available content of elements during vermicomposting and in the final vermicompost. This is consistent with the results of vermicomposting experiments with various types of feedstock [23]. The quantity and quality of the nutrients in vermicomposts can be also explained by the accelerated mineralization of organic matter, increased microbial activity, breakdown of polysaccharides, and higher rates of humification achieved during vermicomposting. The amount of Ca in used paper contributed to the high content of this element in the final vermicompost. On average in all the treatments, the final vermicompost had a lower weight and volume by 20–70 %, and by 55–80 %, respectively, compared to feedstock. Larger amounts of mineral nutrients in vermicomposts compared to commercial plant growth medium were reported [23].

In this experimental work, the higher available contents of P and K were found in the final product compared to feedstock. On average of treatments, available P and K content increased by 30 and 53 %, respectively. The release of P is partly due to the presence of phosphates in the earthworm stomach and subsequently to activity of microorganisms present in the vermicasts [13]. Significant decrease of available Ca during Vermicomposting is in agreement with another study, where 11.5 % loss in the amount of exchangeable Ca in sewage sludge with earthworms was found. It is suggested that the earthworm converts a proportion of Ca from bound to free forms, which can be assimilated through the columnar epithelial layer of their gut as a physiological supplement [22]. The 80 % loss of available Ca in vermicompost from the canteen waste with paper can be explained by increases of earthworm biomass and food availability. In other studies, most vermicomposts contained an adequate amount of macronutrients, micronutrients, and the trace elements of various kinds, but amounts inevitably depended on the type of the parent earthworm feedstock. During the first month, the earthworm biomass was reduced by 44–92 %. Changing environmental conditions could result in stress of earthworms and lead to their death [29]. Before vermicomposting, it is necessary to cool the pre-composted material and let the earthworms crawl there themselves [26]. This knowledge will be used in the construction of a new type of vermibed. The highest earthworm biomass was found during vermicomposting of the canteen bio-waste with paper. Paper seems to be a very suitable feed for earthworms because they are able to produce cellulose enzymes for its decomposition. It is worth noting that earthworms in the substrates liked to form clusters of individuals and this could cause fluctuations in the measured values.

IV. CONCLUSIONS

After the analysis of vermicomposting samples of various days, the above mention results were compared with the researcher results. These are the conclusions of the number of days increase with increase in nutrient. According to the above data, the vermicomposting was modelled on plastic bed, having size12x4x2ft, the waste including garden waste, canteen, and cow dung waste papers with the addition of red earthworms (2.5kg). From the above data conclude that the for process of vermicomposting require temperature and moisture content are 25-27_c and 75-80%.and to complete the vermicomposting require 45-55 days. With high nutrients i.e., P, K, Mg, Ca. Kitchen bio-waste must be pre-composted for more than 2 weeks to reach temperatures below 25 _C. Vermicomposting increased the total content of P,K, Ca and Mg and the availability of P and K. The addition of used paper into canteen bio-waste proved to be a suitable feed for earthworms. Resulting data showed that pre-composting of canteen bio-waste is effective before vermicomposting. The numbers of composting days increases with increase in P,K,Mg,Ca.the result shows that the cow dung having high capacity of decomposition having high concentration of nutrients.

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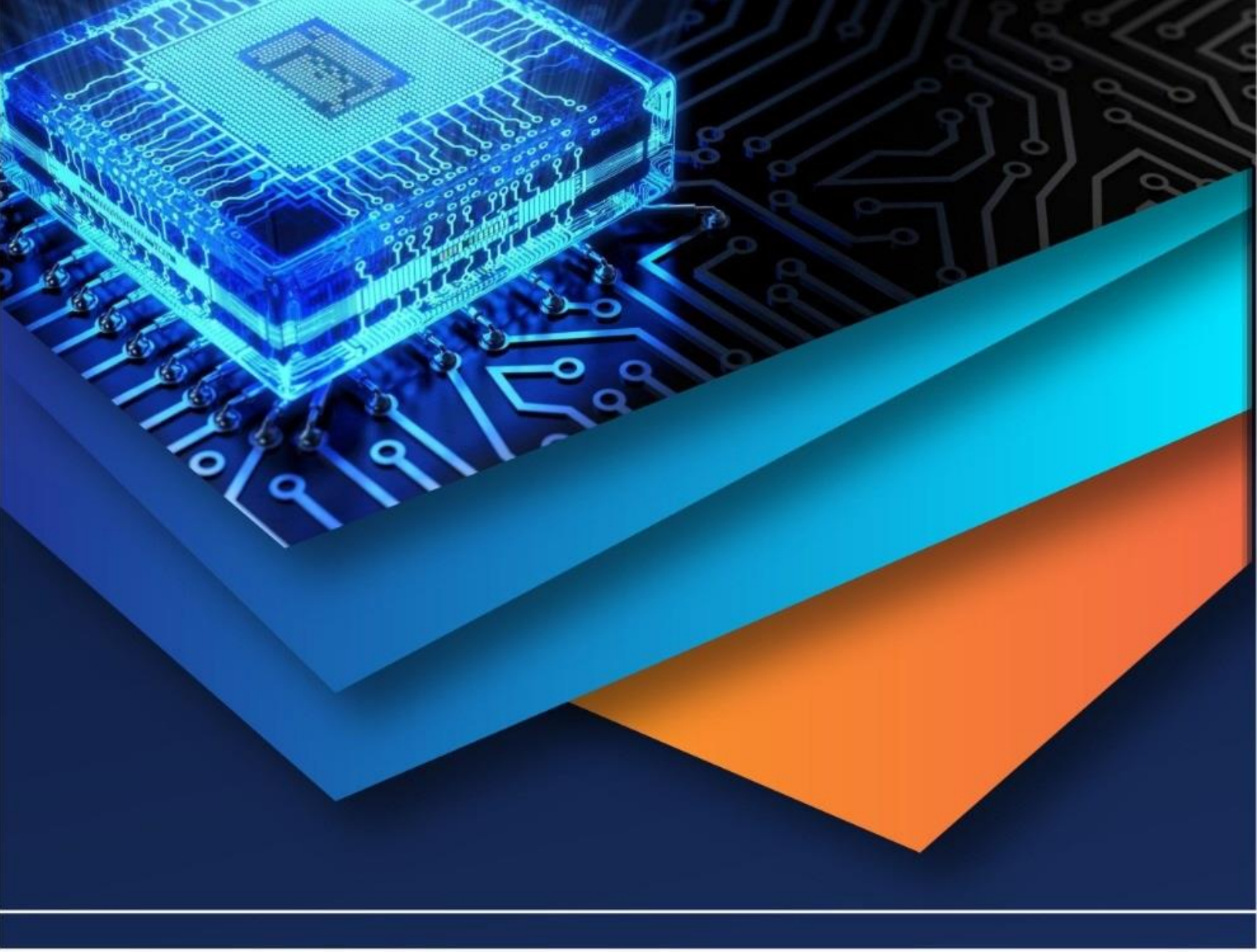

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