iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** IV **Month of publication:** April 2023

DOI: https://doi.org/10.22214/ijraset.2023.50878

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

Lower Head Water Turbine

Prof. Abhishek L. Shimpi[1], Dhananjay Y. Vibhandik[2], Jayesh G. Chaudhari[3], Yash A. Wagh[4], Sachin K. Rane[5]
Department of Civil Engineering, Sandip Institute of Engineering and Management, Nashik, Maharashtra, India

Abstract: ***Increase in human population increases the need for energy. Sustainable energy production is gaining importance day by day. At the same time rapid urbanization and industrialization combined with improper town planning has led to the destruction and death of nearby water bodies. Discharge of drainage water without aeration or any other treatment in Metropolitan Indian cities such as Delhi, Mumbai, Nashik and all others have to led to the blackening of water sources. Indian city drains handle sheer volumes of water every day. A new method of aerating water combined with power generation could go a long way in solving the problem of water treatment as well as power generation. Even under low head this much amount of water if efficiently utilized can generate sufficient power not only for the plant but also for the grid. By using the power of water in vortex flow under gravity, an attempt is made to make power from Indian drains. To generate electricity, water must be in motion. This is kinetic (moving) energy. When flowing water turns blades in a turbine, the form is changed to mechanical energy. The vortex is a form of kinetic energy storage by which water under motion is trapped in a dynamic way. This increased amount of kinetic energy that gets trapped inside a vortex boosts the power inside a vortex.***

Keywords: Sustainable, Energy, Power, Vortex flow, Electricity and Vortex turbine

I. INTRODUCTION

Increase in human population increases the need for energy. Accordingly, the energy consumption increases rapidly. This situation has become a global problem. Countries act irrational and uncontrolled production of energy. On the other hand, developing awareness of saving has been important in personal use. Some studies are to obtain the electric vortex. Siegen investigated on numerical analysis of the influence of Distance between osculating part and surface Water due to ocean current vortex power. Hakim study on a study on the effect of distances between oscillating parts in vortex-associated power generation approach [2]. Permian study effect of free surface on the oscillating part concerning to the performance lies vortex power. As a result; the deeper the location of the oscillating part, the greater amplitude average can be produced and vice versa when tested at a greater speed in the same depth then the resulting amplitude will be smaller. This is due to many reasons, one of which is the holder stability who may not have been perfect [3]. Huda study examined the effect of vortex on plant yield osculating size [4]. Zotlöterer has constructed a low-head power plant that makes use of the kinetic energy inherent in an artificially induced vortex. Bernidnas and friends' study on a new concept in generation of clean and renewable energy from fluid flow. Their work finished successfully and they indicate a lot of advantage in this project. [6]

Sustainable energy production is gaining importance day by day. At the same time rapid urbanization and industrialization combined with improper town planning has led to the destruction and death of nearby water bodies. Discharge of drainage water without aeration or any other treatment in metropolitan Indian cities such as Delhi, Mumbai, Nashik and all others have led to the blackening of water sources [7]. Indian city drains handle sheer volumes of water every day. A new method of aerating water combined with power generation could go a long way in solving the problem of water treatment as well as power generation. Even under low head this much amount of water if efficiently utilized can generate sufficient power not only for the plant but also for the grid. By using the power of water in vortex flow under gravity, an attempt is made to make power from Indian drains.

Hydro power constitutes the cheapest source of power generation even after the recent enormous increase in the cost of equipment and the implementation of civil works. The economic advantages of hydro power have been enhanced in the recent years with the steep increases in the energy costs from fossil fuel and the rapidly approaching limits to the exploitable resources of such fuels. While the importance of hydroelectric development for economic and reliable supply of power is recognized, the share of hydroelectric plants in the overall installed generating capacity is still very low [8]. One of the main reasons behind this situation is the very high capital investment and ecological unbalance a large hydroelectric power generation plant will result in. This scenario demands for smaller coupled power generation schemes that would do much lesser damage to the environment [9], [10]. ArVo power generation scheme requirements are much lesser than the conventional run-of-the-river schemes and the electricity produced by this method is purely green electricity even with slight environmental virtues. So, ArVo power generation is possible at sites with low head and low flow-rate facilitating the construction of many such plants with minimum cost and minimum lead time along the flow path of a river. Fig.1 depicts the basic ArVo power plant.

©IJRASET: All Rights are Reserved

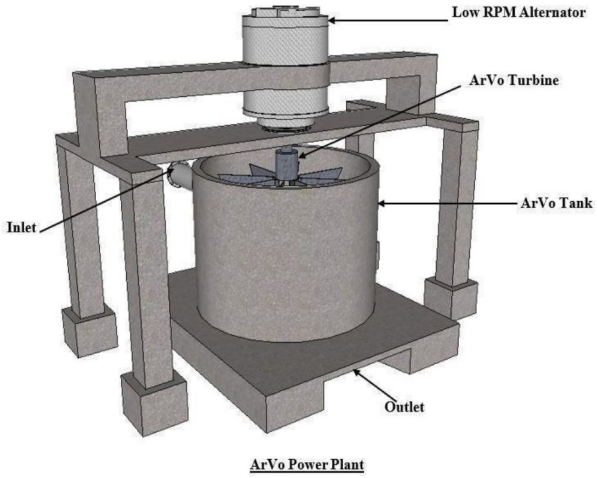


Fig. 1 Basic ArVo Power Plant

Water storage dam used in conventional hydroelectric power generation is basically storing the potential energy of water. A rotating flywheel stores energy mechanically as kinetic energy or more specifically rotational energy and hence can be called a dynamic energy storage device. To generate electricity, water must be in motion. This is kinetic (moving) energy. When flowing water turns blades in a turbine, the form is changed to mechanical energy. The vortex is a form of kinetic energy storage by which water under motion is trapped in a dynamic way. This increased amount of kinetic energy that gets trapped inside a vortex boosts the power inside a vortex. When a small stone is thrown at a chair to knock it down, the impact would be very small that the chair will just vacillate and come back to its stable state. Even if 10 similar stones were continuously thrown at the door one after other at the same velocity, the outcome would be the same. However, a single stone, equalling the mass of the above 10 stones taken together, was thrown at the chair with the same velocity as before, then the impact would have knocked down the chair. The kinetic energies acted upon the chair in both the cases were equal, but not power.

The speed at which energy flows is called power. The same amount of energy can be released at high power (which will occur quickly) or at low power (which will take more time). Power is more with a single stone than ten stones acting on a longer duration of time. Vortex, which has a dynamic steady state, is a good means to keep a fluid in motion with least expense of external energy. In a vortex or a whirlpool, a large quantity of fluid is in motion which enables the fluid to impart more power into the turbine blades compared to utilizing the original flow-rate. In other words, mass flow-rate is largely increased inside the ArVo tank by accumulating lower power inflows. In the last decades, the development of devices that use renewable sources of energy increased in order to protect the environment and reduce the greenhouse effects as a result of fossil fuels use. This initiative in developed countries is already a state policy that has given a boost to the research and development of alternative forms of power generation, complementary to the conventional ones. Unlike these ones, the new devices generate power on a small scale and in a decentralized fashion, without affecting or changing the environment. Taking into account these characteristics, a variety of devices that work with the most common sources of renewable energy has been developed: hydro, solar, wind and from biomass [11]; when the former has a low load is classified as an emerging power almost unused. Human imagination has created different devices to convert hydraulic energy into power on its axis [12-15]. [16] describes some forms of power generation starting from the most basic machines to those made in the second half of the 20th century, showing several choices of energy conversion based on hydropower.

These devices have evolved so much that now there are even technologies that harnessed the vortices with boundary layer separation of the flow around the blunt body. An example of this is the power converter that uses vibration induced by vortices of von Karman [17], similar to the VIVACE system at the University of Michigan [18], but with a non-contact magnetic device to produce electricity. The research of [19] illustrates the current interest in improving energy extraction with hydraulic wheels partially in contact with a water flow, by using hydrostatic pressure. This author develops two types of converters: the undershot-hydrostatic pressure converter and the middle shot-converter of hydrostatic pressure. Lately, the growing demand for electrical power that brings modern life increased the development of new devices to use the energy from water movement. Thus, [20] mentions some new alternatives to transform energy in low head conditions (Baker mill, turbine Division, screw turbine, etc.), and argues that they are redesigning known turbines of action and reaction (Pelton, Francis, Kaplan, etc.) in order to operate at loads below 3 m. [21] performed a review of this type of machines, which focuses on its classification, behaviour, operation and cost.

II. METHODOLOGY

Increase in human population increases the need for energy. Accordingly, the energy consumption increases rapidly. This situation has become a global problem. Countries act irrational and uncontrolled production of energy. On the other hand, developing awareness of saving has been important in personal use. Some studies are to obtain the electric vortex. Siegen investigated on numerical analysis of the influence of Distance between osculating part and surface Water due to ocean current vortex power. Hakim study on a study on the effect of distances between oscillating parts in vortex-associated power generation approach. Permian study effect of free surface on the oscillating part concerning to the performance lies vortex power. As a result; the deeper the location of the oscillating part, the greater amplitude average can be produced and vice versa when tested at a greater speed in the same depth then the resulting amplitude will be smaller. This is due to many reasons, one of which is the holder stability who may not have been perfect. Huda study examined the effect of vortex on plant yield osculating size. Zotlöterer has constructed a low-head power plant that makes use of the kinetic energy inherent in an artificially induced vortex. Bernidnas and friends' study on a new concept in generation of clean and renewable energy from fluid flow. Their work finished successfully and they indicate a lot of advantage in this project.

Sustainable energy production is gaining importance day by day. At the same time rapid urbanization and industrialization combined with improper town planning has led to the destruction and death of nearby water bodies. Discharge of drainage water without aeration or any other treatment in metropolitan Indian cities such as Delhi, Mumbai, Nashik and all others have led to the blackening of water sources . Indian city drains handle sheer volumes of water every day. A new method of aerating water combined with power generation could go a long way in solving the problem of water treatment as well as power generation. Even under low head this much amount of water if efficiently utilized can generate sufficient power not only for the plant but also for the grid. By using the power of water in vortex flow under gravity, an attempt is made to make power from Indian drains.

Hydro power constitutes the cheapest source of power generation even after the recent enormous increase in the cost of equipment and the implementation of civil works. The economic advantages of hydro power have been enhanced in the recent years with the steep increases in the energy costs from fossil fuel and the rapidly approaching limits to the exploitable resources of such fuels. While the importance of hydroelectric development for economic and reliable supply of power is recognized, the share of hydroelectric plants in the overall installed generating capacity is still very low. One of the main reasons behind this situation is the very high capital investment and ecological unbalance a large hydroelectric power generation plant will result in. This scenario demands for smaller coupled power generation schemes that would do much lesser damage to the environment . ArVo power generation scheme requirements are much lesser than the conventional run-of-the-river schemes and the electricity produced by this method is purely green electricity even with slight environmental virtues. So, ArVo power generation is possible at sites with low head and low flow-rate facilitating the construction of many such plants with minimum cost and minimum lead time along the flow path of a river.

A. Methodology Flow Chart

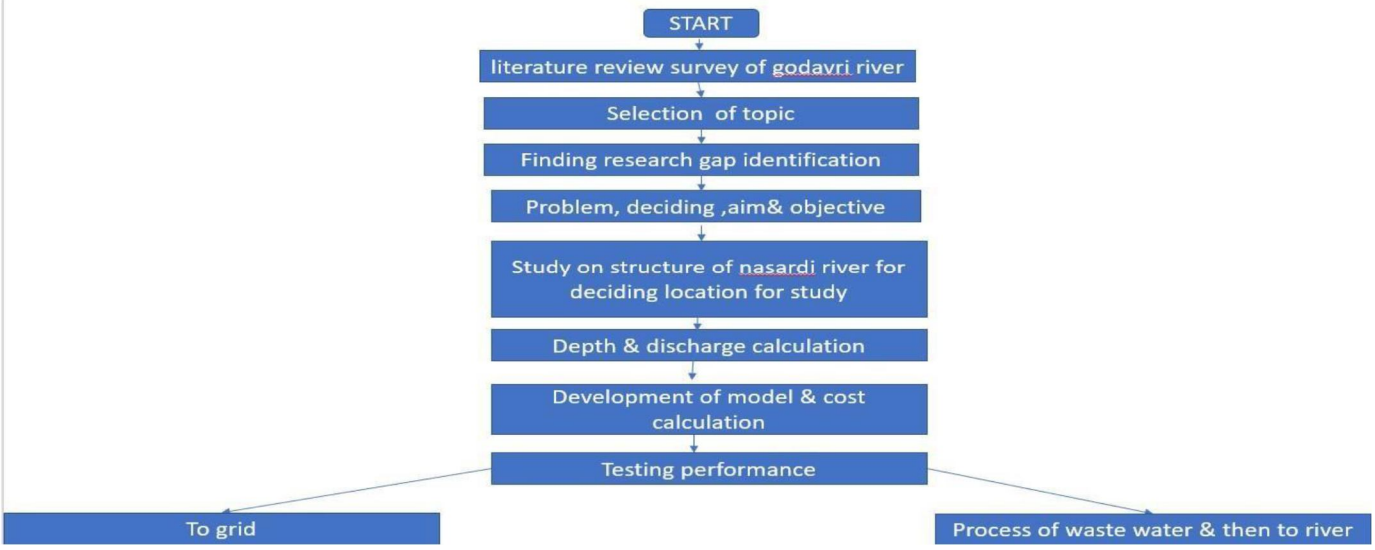


Fig. 2 Flow Chart

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

III. LITERATURE REVIEW

An approach for the implementation of technology in developing countries for power generation and the impact on local communities within the framework of the sustainable development goals is presented. The significance of small and micro hydropower in a rural setting and the influence on the population is discussed. presents an overview of hydropower machines and the machine to be modelled. The chapter introduces various hydropower machines, from the ancient water wheel to modern machines and the fundamental equations used to calculate the power in hydraulic systems. The machine developed in the HYLOW project is described.

An overview of Hydropower application to the waste water (Sewage) is described here. Firstly, the waste water treated in Sewage Treatment plant. It includes physical, chemical and biological contaminants. Its objective is to produce an environmentally. Here the solid waste (treated sludge) suitable for disposal of reuse (usually for fertilizers) and treated water used for generating electricity by a small Hydro power plant. Treated water of sewage at a high pressure or flowing with a high velocity can be used to run turbine or water wheel coupled to Generator and therefore of electrical power is becoming more and more popular as it is reliable and requires least maintenance and care. Output power has been estimated for available different head and flow rate of the waste water. Various types of the turbine-generator set for different available head have also suggested for reliable operation of the developed this plant. The main advantage of this power plant is an independent power plant; it is not dependent on the monsoon because the availability of sewage water is always maintained. Electricity generation through this method is costlier in initial cost but cheapest in maintains and production cost. This plant is focused on reducing fuels. This plant has used a range of innovative solution, including renewable energy and local generation to meet future growth needs while improving efficiency reducing cost. Hydropower is a renewable, non-polluting and environmentally benign source of energy. Hydropower is based on simple concepts moving water turns a turbine, the turbine spins a Generator and electricity is produced. The use of water falling through a height has been utilized as a source of energy since a long time; it is perhaps, the oldest renewable energy techniques known to the mankind for mechanical energy conversion as well as electricity generation. Small scale hydropower was the most common way of electricity generating in the early 20th century.

The first commercial use of hydroelectric power to produce electricity was a waterwheel. Micro hydropower system is one of the popular renewable energy sources in the developing countries. Small hydropower system (SHPS) is relatively small power sources that are appropriate in many cases for individual users who are independent of the electricity supply grid. Hydroelectric power is the technology of generating electric power from the movement of water through rivers, streams and tides, water is fed via a channel to a turbine where it strikes the turbine blades and causes the shaft to rotate . To generate electricity the rotating shaft is connected to generate which converts the motion of the shaft into electrical energy. A Sewage micro hydropower system can be reliable and provide stable electrical energy micro hydropower system using waste water from community neither requires a large dam nor a land flooded. Only waste water from different part of the city is collected to generate power which has minimum environment impact. In this system, water collected by sewage of city and then this water treated in water of sewage at a high pressure or flowing with a high velocity can be used to run turbine or water wheel coupled to generator and therefore of electrical power is becoming more popular as it is reliable and requires least maintenance and care.

The use of renewable energies reduces the impact of greenhouse gases and other negative influences on the environment. Hydropower in its role in renewable energy sources is the largest contributor to this sector with the expected global share doubling, accounting for 30% of all electricity production by 2035 (UN-Water, 2015). Large hydropower projects require large investments and have to fulfil environmental standards. These are not always fulfilled, especially in countries with weak economies, due to the high costs involved. Additionally, the costs for the planning and construction of the required infrastructure for an electricity grid further increase costs.

The transfer of electricity to regions with low population densities is often not feasible. An alternative for such regions is local power generation. This can be achieved in various ways, with different environmental impacts. The installation of a diesel generator is one such example. Renewable energy sources in the form of photovoltaic, wind or small (low head) hydropower may be deployed where resources are available.

The power generated may be connected to local users or be distributed within a local grid. Small hydropower using appropriate technology can be implemented on small scale projects. The tapping of hydropower resources with machines like water wheels can bring social benefits for the surrounding communities with local power generation. These social aspects are reflected in the United Nations Sustainable Development Goals (SDGs) which show the all-encompassing effects of energy availability. The SDGs are based on the success of the Millennium Goals and describe the challenges that lie ahead.

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |

A. Literature Survey

TABLE I

Sr. No.	Author's name	Attempted work
1	Sezgin Ersoy	Water flowing through the wings of these turbines causes it to rotate hence generates electricity
2	Anubhuti Agarwal	Various low head (up to 3 m fall) based technologies provide a more acceptable perspective to the potential that has not yet been utilized in an efficient way.
3	Shpetim Lajqi, NaserLajqi*, Beqir Hamidi	quantities of electrical energy capable of meeting the requirements of individual users starting from water resources which would otherwise be wasted.
4	Christine Power, Aonghus McNabola, and Paul Coughlan	GVHP exploits the energy available in a vortex flow, enabling hydropower generation at heads as low as 0.7m.
5	Anjali Mohanan M	. An idea of a power plant that houses theseturbines is outlined in this paper
6	Efraín Baldemar del Risco-Moreno	The device has a semi-convergent nozzle withflat walls, a cylindrical Vortex Chamber and a Runner
7	. O. Anaza1*, M. S. Abdulazeez2, Y. A. Yisah3, Y. O. Yusuf4,	Challenges such as carbon dioxide (CO2) emissions and depletion of conventional source of energy necessitate for renewable sources
	B. U. Salawu5, S. U. Momoh	
8	A.G. Pradeep Narrain	Growing energy demand together with increasing environmental concerns has widened the interest in hydropower generation
9	Xiaobo yang, chengyan yue, dawei yao, chunming yuan	variable speed operation of hydropower plant with HVDC station (unit connection) becomes technically and commercially feasible
10	Kiran P Huparikar, G R Naik	used at sites having head range of 0.5 to 6 m

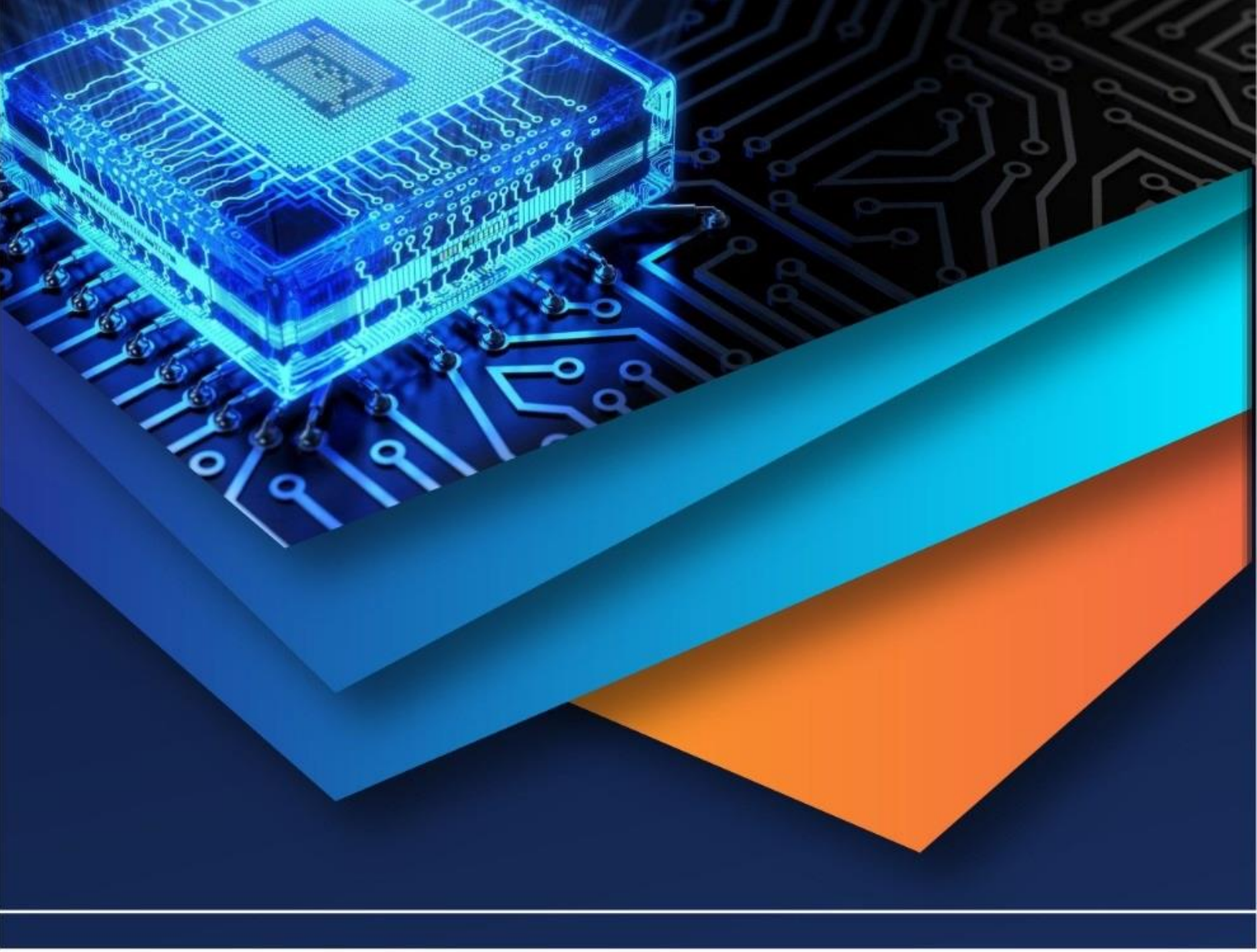
IV. CONCLUSIONS

In this study, our aim is not to provide high values of electricity generation. Only, renewable electricity produces the design water flow. Meanwhile, this system will use in many areas such as dam, river and sanitary installations. Obtained in this study with a small vortex is provided at the level of about 1 volt of electricity generation. Many factors had caused power loss such as fraction and used materials. These effects can be reduced to systems prepared with a better budget. This system is planned to be formed if the yield of plants is higher than the normal system of the dam that will become advantageous to use. This system can be added as an innovation in the design of hydroelectric power plants.

REFERENCES

[1] Hydro Power Opportunity in the Sewage Waste Water Archana Tamrakar1, S.K. Pandey and S.C. Dubey
[2] A Parametric Experimental Investigation of the Operating Conditions of Gravitational Vortex Hydropower (GVHP) - Christine Power, Aonghus McNabola, and Paul Coughlan
[3] Micro Hydro-Electric Energy Generation- An Overview S. O. Anaza, M. S. Abdulazeez, Y. A. Yisah, Y. O. Yusuf, B. U. Salawu, S. U. Momoh
[4] Horizontal vortex single chamber hydro turbine, ergio Antonio Zarate-Orrego, Gerardo Andrés Torres-Casierra, Efraín Baldemar del Risco-Moreno
[5] Power Generation with Simultaneous Aeration using a Gravity Vortex Turbine - Anjali Mohanan
[6] Vortex with the Formation of Electricity Generation and System Modelling - Sezgin Ersoy
[7] Low Head Hydropower for Local Energy Solutions - A.G. Pradeep Narrain

©IJRASET: All Rights are Reserved | SJ Impact Factor 7.538 | ISRA Journal Impact Factor 7.894 |



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Call : 08813907089 (24*7 Support on Whatsapp)