

Solar Based Potable Water Purification using Tandem Solar Cells and Anionic Polyacrylamide Alum

Muhammad Shehram^{1*} and Uzma Rani²

¹Graduate School of Engineering Science & Technology Hamdard University, Karachi, 75500, Pakistan (muhammadshahram67@gmail.com)*

² Preston University Institute of Management Science and Technology Islamabad Campus, Pakistan

Abstract: In Pakistan when potable water is very rapidly threatened, it is very important to announce method to purification of water with renewable energy resources. Pakistan is developing country that facing scarcity of appropriate drinking water and limited of storage system. In our recommended design water has been purified by using tandem photovoltaic cells anionic polyacrylamide and alum. Tandem photovoltaic cells have been used to improve the performance of the solar module, because they consume the full spectrum of the sun and each band gap produce its own energy. These cells are used to enhance the efficiency and well utilization of solar spectrum. The electric current is used to warm up water for 30 minutes at 120 degree for purification of water from bacteria (such as shigella), protozoan (such as entamoeba), e.coli (such as vibrio) and viruses (norwalk virus), because when water boiled for 30 minutes mostly microorganism become dead. The anionic polyacrylamide used for boost of flocculation of particles presents in water and allow rapidly settlement of fine suspended particles. Alum is use for removal of industrial waste. Then used charcoal filter paper for filtration of water, the clean water is store in a large tank. The purifications of water from PV side reaching on peak during the summer days because irradiation intensity is on peak during summer days. The battery is charged by using solar photovoltaic energy. The battery is use in night to drive the purification system. The output result shows that the proposed solution environment friendly, low cost and working day and night.

Keywords: Potable water, tandem solar cells, anionic polyacrylamide, alum, activated charcoal filter paper, microorganism

I. INTRODUCTION

Water is a central need of human for enduring. The significant aspect of the word doesn't have consumable water for drinking which is significant concern. In country zones there is no power and no disinfection hardware is accessible to clean water for drinking reason. Huge amounts of new water are required for horticultural, modern and homegrown employments. Sun powered photovoltaic based framework has been proposed in this paper, which purged the water to get it drinkable. Sun oriented PV module create vitality and to drive the framework, it is inexhaustible and wellspring of vitality and efficient and have less effect on an earth-wide temperature boost. Many creating nations simply like Pakistan required introduced this kind of venture to beat the water emergencies. Water is basic to life. A satisfactory, preserved, and bears gracefully easily approachable to everyone. The accessibility improved towards the drinking safe water and easily approachable. Every activity must be done to achieve drinking water quality as sheltered as could reasonably be expected [1].

Specific use, water cleaning can incorporate the purification of surface and ground water from sources, e.g, lakes and streams. Report of the International

Starting today, almost one fourth of individuals are experiencing insufficient clean water flexibly [2]. Water supplies adequate to meet fundamental human needs are obviously basic for keeping up and improving the government assistance of all occupants in the locale. The necessities of clean water will be increment request step by step next hardly any decades. Maximum area of the world's surface is secured with water.

Nonetheless, the majority of the accessible water is seawater lakes, waterways or icy mass in the Polar Regions. About 97% of the world's water is pungent and rest is clean water and less than 1% of clean water is addresses human issues. Along these lines, water uses expanded seven overlays since 1900. Altogether, water request duplicates each long term [3]. Subsequently, 40% of the total population is battling with serious water shortfall. It is basic to set up a framework for water cleaning. Water decontamination is broad topic and can by and large be characterized as the expulsion of defiles from water so as to make it appropriate for a

Monetary Fund (IMF), showed that Pakistan positioned number three in overall world nations confronting extreme water lack. The report was declared in may

2018; the Pakistan council of research in water resources (PCRWR) declared in 2025, there will be less water remains for drinking and other usage [4]. It should be traced that per person accessibility in the year of 1950s was roughly 5000 m³ for every year, now it is reduced to less than 1000 m³, which is a globally perceived edge of water shortage [5].

Right now, just 20% of the nation's populace approaches clean consumable water. The staying 80% populaces relies upon dirtied water basically polluted by drain water (corrupt, complete coliforms, E. coli provinces), and optionally by manure, pesticides, and mechanical effluents [6]. Such water contamination is liable for roughly 80% all things considered and 30% of passing. In the shriveled pipeline, a solitary E. coli bacterium can duplicate into trillions in only seven days, and such lines are utilized for the water gracefully with no treatment. Usages of such dirtied waters has not just brought about the demise of a few people, yet in addition purpose bone and teeth infections, the runs, diarrhea, typhoid, hepatitis, malignancy, and other waterborne illnesses [7]. As indicated by the international organization (WHO), mobile dysentery infections are answerable for more than 2 million passing every year over the world,

with the lion's share causing in kids whose ages are below five (world health organization 2018). In Pakistan, around 60 million individuals are in danger of being influenced by high convergences of arsenic in consumable water. Arsenic harming can cause malignant growth, prohibitive aspiratory illness, skin injuries, cardiovascular issues, metabolic disease, gangrene, sensational impedances, and issues in endocrine organs, insusceptibility, liver, kidney, and bladder just as financial perils [8].

Lamentably, still, no epidemiological information of arsenic harming, substitute potable water and wellbeing mediations are accessible to the individuals in danger. Moreover, absence of administrative and commonplace government's advantage, water struggle between atomic equipped Pakistan and India [9], deforestation, the mind-boggling expected danger to the nation's glacier reserves [10], and the poor water flexibly will probably adversely influence horticulture, biology, and nearby biodiversity. The natural life is in dangerous zone due to inhaling contaminated water [11] and can transform into human emergency with the threat of enormous scope local movement of individuals because of dry spell like circumstance.

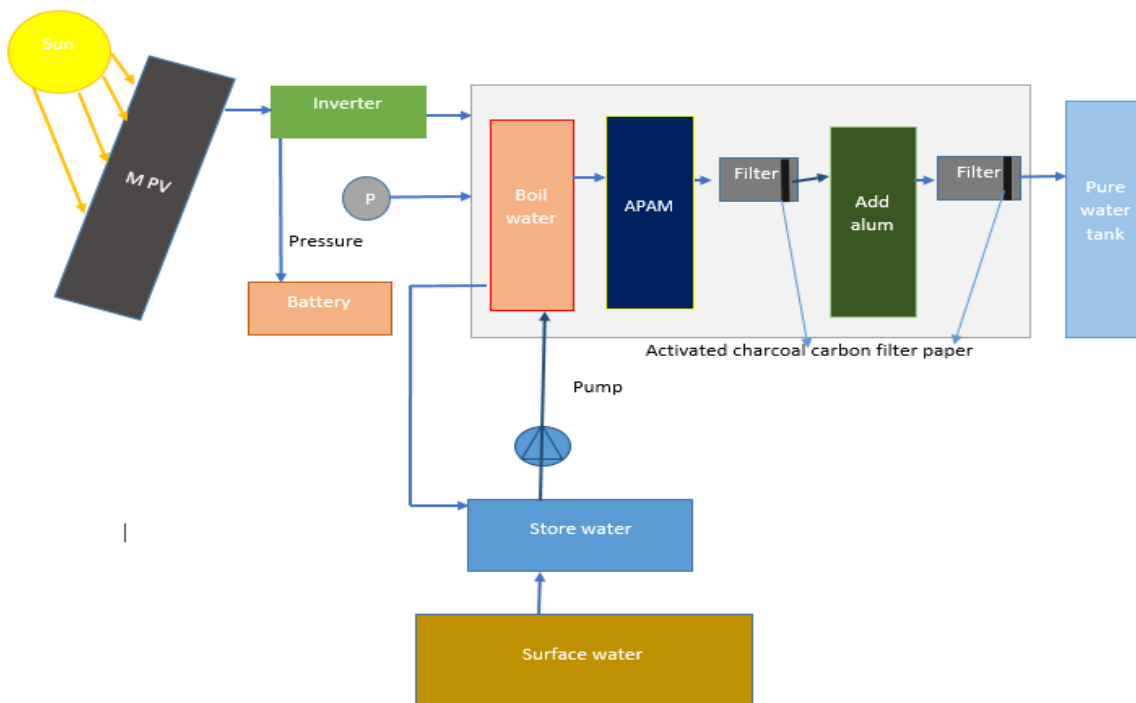


Fig1 Solar based water purification process

Water taints are separated into two principle types: natural and concoction. Natural taints incorporate waterborne microorganisms and algae [12]. Waterborne microbes can cause serious infections like diarrhea. Microbes, for example, protozoans and cryptosporidium

are perilous in consumable water yet additionally have a danger when found in water utilized for the water system of harvests that are utilized crude [13].

Synthetic pollutants incorporate heavy particles just like arsenic and mercury [14] and substances like salt when present in high concentration. Numerous industries and former workers with synthetic chemicals that end up in water. These incorporate synthetic substances that are utilized to control weeds, insects and pests. Metals and solvents from industries can taint water bodies. These are risky to numerous types of aquatic life and human, and may slow their turn of events, make them fruitless and their death happen. The NIH of Pakistan detailed in year of 2011, not long after the presence of a cholera flare-up, 67% of individuals are inhaling unclear water directly from the stream [15].

A tandem solar module based portable water treatment system is proposed in this paper. These are little logic which offered life to this kind of framework. The individuals in the rustic zones face numerous emergencies and are not open to clean potable water, which formed the reason for the individuals falling sick what's more, getting sicknesses, as the resistance of these individuals diminishes lastly makes them prone to diseases. Maximum world's water is profoundly contaminated water [16]. Water is treated by using tandem PV cells to improve the efficiency and alum is used to remove the TDS and industrial waste. At that point a versatile framework is created, which is used to convert the dirty water into potable water which is able to be used, inside a instant and has better productivity and furthermore economical. The charcoal filter paper can eliminate the smell and also working on the change of colour and taste of the water [17].

II. PROPOSED DESIGN

The Objective of proposed design is to produce low cost efficient water purification system, which is environment friendly and occupy less space. In this design tandem solar cell concept has been used to improve the efficiency of photovoltaic side. Alum has been used which removes the industrial waste and cheap in price. Anionic polyacrylamide is used which removes the microorganism from the water and becomes water to be potable.

Novelty

In this research work tandem solar cells concept is introduced, which raised the efficiency of solar cells up to 42%. On the other side alum is used which is cheap and easily available, it removes the colour in potable water and industrial waste and anionic polyacrylamide is utilized which is an organic compound and done the coagulation process in water.

III. METHODOLOGY

In water purification process we use the solar cell to drive the cycle of water purification

A. Tandem solar cells

Tandem PV cells are comprised of various materials and their band hole vitality and its reaction to various frequency of light and ingest distinctive shade of light and convert it into electrical vitality are called multi-intersection sun oriented cells. These cells are utilized to improve the effectiveness and better use of sun based range [18]. It has in various intersection single intersection, twofold intersection and triple intersection sun powered cells.

In single intersection sunlight based cells it has simply retain one kind of light, twofold intersection sun oriented cell it ingest two sort of light Red and green and in triple intersection sun powered cell it assimilate three kind of light blue, green and red. These lights are relying on the no of frequency. Multi-intersection sun powered cells have diverse band hole rely on the cross section vitality of the material which is utilized arrangement of module. Fig2 given below show the tandem solar cells

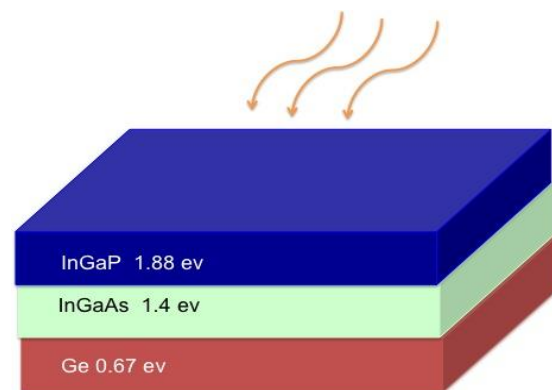


Fig2 Tandem solar cells

In this research work utilize tandem solar cells. In tandem solar cells three sort of material have been utilized more lattice energy [19]. At the subsequent green colour cell have been utilized which have band gap energy 1.4eV. It is additionally more sensitive to light and retain green colour light which discharge from sun. After absorbing light from top cell remaining absorb by this cell usually gallium arsenide have been utilized for this reason. It's also very sensitive to energy.

Toward the end gallium have been utilized which have 0.7ev energy of band gap. Subsequent to retaining top and center cell energy remaining ingest by base cell it have longer frequency as contrast with the other. It has less lattice heat of mismatch.

B. Anionic polyacrylamide

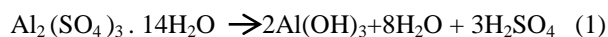
The Anionic polyacrylamide dissolves in water. The anionic polyacrylamide that reacts with waste water and takes out mechanical and heavy metals, anionic polyacrylamide is a white powder a viably separate in water. . Anionic polyacrylamide (APAM) is such a polyacrylamide (PAM) and shows electronegative which contains obliging social occasions of sulfonic perilous, phosphoric hurting or carboxylic ruinous. Contemplating more charge, the atomic chain of polymer can be other than interfacing in the water which will make the key of adsorption and improvement for suspended particles clearing.

The overall coordinated effort among APAM and suspended particles is power passed on by methods for beating, hydrogen holding or covalent security. Anionic polyacrylamide with high sub-atomic weight and brilliant dissolvability property can be an uncomplicated sort of flocculants. Moreover, it has been reliably consumed in water treatment considering mind blowing flocculation execution.

C. Alum

Aluminum and sulfate broadly utilized as a purification of water in the United States. It is additionally broadly accessible in commonwealth countries, sold in squares of delicate white colour stone, and commonly called alum. There are various approaches to utilize alum as a flocculant, including to smash the alum into a white powder before adding it to water, blending and emptying or mixing the entire stone in the water for a couple of moments and remain under wait for the solids

will settle. The advantages of alum are that it is broadly accessible, is demonstrated to diminish turbidity, and is economical. At the point when alum is mixed to water, it reacts with the contaminated water and output is produce cationic ions. Coagulation/flocculation is a cycle used to eliminate turbidity, color, and a few microorganisms from water. Coagulation eliminates large and mixed solids from the water. Impurities in the water contain anionic ions, so the cationic ions coagulant synthetic compounds neutralize them during coagulation. At that point, during flocculation, the particles are bonded together by weak van der Waal's forces, framing floc. The coagulation/flocculation measure is influenced by pH, salts, alkalinity, turbidity, temperature, blending, and coagulant synthetic chemical.



Activated charcoal carbon filter

The actuated charcoal carbon based purifier filters are best in eliminating chlorine, residue particles, unstable natural mixes, taste, odor, and organic compound and inorganic compound from the contaminated water. In this process carbon is a cationic ion and pulls the anionic ions of contaminated water towards itself and clean the water it is powerful because of it is a large number of small pores that can retain the soil particles. carbon is the most permeable material.



Fig3 activated charcoal filter paper

IV. RESULTS

The study has focus on water purification from tandem photovoltaic cells system and Alum. The contaminated water has lots of microorganism that causing different diseases. Too much sources of water pollution which is given as, chemicals and minerals (arsenic, radon, and uranium), local land use practices (fertilizers, pesticides, and concentrated feeding operations), manufacturing processes, and sewer overflows or wastewater releases.

The microorganism in contaminated water is become dead when heat at 120 degree. The process is meant to destroy or deactivate microorganisms and enzymes that contribute to deterioration or danger of disease, including vegetative microscopic organisms, protozoan and parasites yet not bacterial spores. Since at 120 degree doesn't kill spores, second "twofold" warmth will expand the norm by killing spores that have sprouted. In water tank temperature is about 120 degree for 30 minutes the mostly microorganisms become dead.

At high temperature the enzymes of microorganism is destroy, because at high temperature the structure of enzymes are denature. The microorganisms genetic material completely denature at high temperature. Further activated charcoal carbon filter paper is utilized for purify the water. The benefits of utilizing an activated charcoal carbon filter are that it can eliminate all the dregs, minute particles, and even the odor. It is additionally little and minimal, in this way keeping the heaviness of the framework down. Another preferred position of utilizing this sort of filter is that it tends to be utilized for around multiple times and is additionally conservative, along these lines making it entirely reasonable for all .

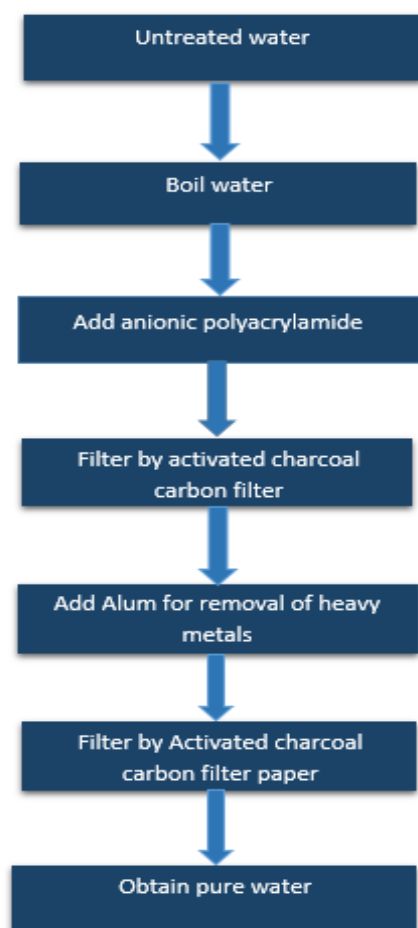


Fig4 Purification steps

V. CONCLUSION

This study has primary focus on purification of water from tandem photovoltaic cells technology and integrating Alum both tandem PV and Alum toward building a water purification system. Solar energy may be a fruitful and less damage of our eco system that's why this is source of energy. Increasing the demand of

potable water, there is need to develop simple and economical water purification system that employ solar energy and other sorts of renewable energy. While many sorts of solar energy based treatment of water are developed, addition of tandem solar cells is one of its properties which improve efficiency of the system. The efficiency of water purification is greatly increased with the introduction of alum. The microorganism is completely inactivated after 30 minutes. The industrial waste and heavy metals are removed by using alum. At the point alum included with water, it responds with the water and results produced cationic ions. Coagulation/flocculation is a cycle used to eliminate turbidity, color, and a few microorganisms from water. Coagulation eliminates heavy and mixed solids from the water. Impurities are anionic ions, so the cationic coagulant synthetic compounds neutralize them during coagulation. At that point, during flocculation, the particles are drawn together. . It is used in very small quantity and is not dissolved in water.

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