

Algae in Air Pollution Control: A Review

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Abstract: Air pollution is growing alarming scenario daily. Various primary and secondary air pollution are the reasons in the back of it which can be fashioned with the aid of diverse stimuli. To conquer the threats various, manage technologies like cyclonic separation, numerous scrubbers, hydrodynamic separator and so forth had been used. One extra technique bio - filtration is used which makes use of dwelling micro or macro - organisms to biodegrade waste or dangerous materials. Air pollutants may be eliminated with the aid of the method of bio filtration. It may additionally cause damage to other dwelling organisms which include animals and food crops and may additionally harm the natural or built environment. Human pastime and natural strategies can each generate air pollutants. Here an organic method is getting used to take away the pollutants present within the air. Air pollution are essentially the overseas material inside the air - can be artificial or arise naturally, and are focused wherein human beings are concentrated. Pollution is injurious to fitness and its prevention places a monetary burden at the citizen. Further emission discounts from automobiles, and transportation measures and programs may be greater hard to perform, however the project has been supplied. The choice is up to the citizenry as to whether there will be smooth air for all - and at what price. Air pollutants have been a menace in latest years posing severe threats to environmental and social wellbeing. Government, authorities and enterprise have been at the forefront to tackle air pollutants with the help of coverage reformation and technological innovation. The intention is to understand the innovation pastime in the technology area and the distinct methods to take a look at patterns in relation to diffusion of innovation in special jurisdictions. We emphasize on distinguished Indian business enterprise active in air pollution control measure dewy innovative generation business and R&D practices. Paper highlights various nations on the priority listing of enterprise technologies for protection and exploitation of evolved technologies. Suggestions for destiny followed technology for air pollution manage adopted under Indian criterion is also suggested.

Keywords: Air pollution, Air quality standard, Algae, Coconut fibre bed, Spirulina, Photosynthesis, Absorbance, Optical density, oxygen

1. Introduction

Air pollutants are basically the overseas fabric in the air-can be artificial or occur clearly, and are concentrated where human beings are concentrated. Pollution is injurious to health and its prevention places a financial burden at the citizen. Further emission reductions from cars, and transportation measures and packages can be tougher to accomplish, but the project has been presented. The choice is as much as the citizenry as to whether or not there will be smooth air for all-and at what price. Air pollutants have been a menace in latest years posing extreme threats to environmental and social well - being. Government, government and industry have been at the leading edge to tackle air pollutants with the assist of policy reformation and technological innovation. The aim is to apprehend the innovation hobby within the era area and the distinctive methods to observe styles in terms of diffusion of innovation in distinct jurisdictions. We emphasize on distinguished Indian organization active in air pollutants manage measure dewy progressive generation enterprise and R&D practices. Paper highlight's various international locations on the priority list of enterprise technology for protection and exploitation of evolved technologies. Suggestions for destiny followed technology for air pollution control followed beneath Indian criterion is likewise suggested (Kumar1, (2013)).

Air pollution is growing daily and its threat is becoming a mission which we want to conquer. Every existence form one manner or every other is getting tormented by this risk. Air pollution are due to various pollutant may additionally it's number one like sulphur dioxide, carbon monoxide, risky natural compounds, chlorofluorocarbons CFCs and so on or secondary like ozone, peroxyacytele nitrate (PAN). Each pollutant has its private threats to us, out of which a

few creates grave hazard to human life. According to IS code 15200 - 2002 code of protection for hydrogen sulphide, even as it exceeds the permissible restrict of 10 ppm is fatally poisonous gasoline which influences respiratory tract, even causes skin irritations and eye itchiness. To check threats by way of manner of pollution various strategies like absorption, adsorption, bio filtration and lots of others are there (Balendu Shekher Giri, January 2014). Biofiltration approach is one in each of maximum green technique which takes microorganisms in motion to deal with polluted air. This bio filtration method has used bacteria and fungi in bio movie. We have algae in extremely good quantity and these algae are very tons efficient in taking pictures carbon dioxide and the usage of that in their in - addition growth (P. M. Ndegw, March 2008). Algae's contribution in Oxygen interest might be very well known and preferred. So why not to apply algae for air pollution manipulate method? So, purpose of this task is to use the ones algae and take a look at if they can cope with polluted air. For that we first want to deliver identified attention of any pollutant. Hydrogen sulphide may be produced thru Kipp's equipment the usage of sulphuric acid and ferrous sulphate (&Sons, 1900). To understand the attention of produced hydrogen sulphide iodometric decrease lower back titration technique may be completed. The bio filters out mattress may be produced using various materials like wooden chips, peat, plastic media of various shapes, glass and so forth. In this technique, coconut fibre has been used to prepare filter mattress. The algae were gathered from neighbourhood ponds and used for filtration (BAGH).

Air pollutants is the introduction into the surroundings of chemicals, particulates, or biological materials that cause soreness, loss of life, or loss of existence to humans, harm different living organisms along with food vegetation, or harm the natural environment or constructed surroundings.

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A substance in the air that may be detrimental to humans and the environment is known as an air pollutant. Pollutants may be in the form of solid debris, liquid droplets, or gases. In addition, they may be natural or man-made (Madden, 2020). Pollutants can be classified as primary or secondary. Usually, primary pollutants are at once constituted of a method, collectively with ash from a volcanic eruption, the carbon monoxide gas from a motor automobile exhaust or sulphur dioxide launched from factories. Secondary pollution isn't emitted straight away. Rather, they shape in the air whilst number one pollutants react or have interaction. A critical instance of a secondary pollutant is floor degree ozone – one of the much secondary pollution that makes up photochemical smog (Mondal). Some pollutants may be every primary and secondary: this is, they will be every emitted immediately and fashioned from other number one pollution. Major primary pollution produced by means of using human interest includes Sox, NOx, CO, particulate, CFCs, NH₃ & Radioactive pollution (Pri2).

1.2. Parameters of air quality

Air pollution includes a complex blend of several materials in top notch physical and chemical states and those get up from several assets. Many of them are believed to be gravely harmful to human fitness. Eminent global institutions just like the World Health Organisation (WHO) remember a high-quality set of air pollution signs to get toward quantification and monitoring of air pollution as quantification of all of the air pollution has no longer however been viable on a global scale. WHO makes a speciality of four health-related air pollutants, specially, particulate rely (PM), measured as debris with an aerodynamic diameter lesser than 10 µm (PM₁₀) and lesser than 2.5 µm (PM_{2.5}), nitrogen dioxide, sulfur dioxide and ozone. The awareness on simply the ones 4 is for the sake of tracking the overall nation of air great and it does now not suggest that the alternative air pollution do now not affect fitness of people and that of the surroundings (2006) According to the Indian Government (CPCB), Indian AQI range is from 0 - 500, from 0 being good and 500 being severe. There are eight major pollutants to be taken into account for AQI calculation, viz. particulate matter (PM₁₀ and PM_{2.5}), carbon monoxide (CO), ozone (O₃), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), ammonia (NH₃), and lead (Pb). To calculate AQI, data for a minimum of three pollutants must be present, of which one should be either PM₁₀ or PM_{2.5}. AQI ranging from 0 - 500 has different concentrations for each pollutant and has health effects accordingly (CPC).

2. Literature Review

In this section the literature meeting the purpose of study i. e., application of algae in air pollutants manipulate method is reviewed. Algae create extra than 70% of oxygen with the aid of photosynthesis. Air contamination is caused when hurtful substances are brought into the world's air. It might likewise cause mischief to other living creatures, for example, creatures and food crops and may likewise harm the normal or constructed climate. Human action and normal cycles can both produce air contamination. Here an organic technique is being utilized to eliminate the poisons

present in the air. Green growth, for example, spirulina which is fit for decreasing the carbon - di - oxide (CO₂), nitrogen dioxide (NO₂) also, sulfur dioxide (SO₂) in the contaminated air and creating oxygen. The gear contains the way of life tank filled with the way of life liquid including green growth and air supply unit. By emanating the light all through the hardware utilizing daylight during the morning and fluorescent lights during night within the sight of carbon - di - oxide (CO₂) photosynthesis will happen, where the transformation of the carbon di oxide happens which brings about the oxygen creation. Notwithstanding it green growth uses nitrogen dioxide (NO₂) and sulfur dioxide (SO₂) as supplements during the photosynthesis. Thus, the contaminated air which is gone through the hardware creates the filtered air, which has high centralization of oxygen (Saurabh Srivastava1, Mar 2020). Air contamination is essentially the unfamiliar material in the air - can be artificial or happen normally, and are concentrated where individuals are concentrated. Contamination is damaging to wellbeing and its avoidance places a monetary weight on the resident. Further outflow decreases from vehicles, and transportation measures and projects will be more hard to achieve, yet the test has been introduced. The choice really depends on the populace with respect to whether there will be spotless air for all - and at what cost. Air contamination has been a danger as of late presenting serious dangers to ecological and social prosperity. Government, specialists and industry have been at the bleeding edge to tackle air contamination with the assistance of strategy transformation and mechanical advancement. The point is to grasp the development action in the innovation space and the various ways of noticing designs according to dispersion of development in various locales. We accentuate on unmistakable Indian organization dynamic in air contamination control measure dewy creative innovation business and R&D rehearses. Paper features different nations on the need rundown of industry advances for security and abuse of created advancements. Ideas for future took on advances for air contamination control took on under Indian basis is likewise proposed (Katoria, 2013). Wastewater may be used as microalgae complement and algal biomass should get the opportunity to be, soon, a budgetary and suitable fabric for unique removal of heavy metals from waste water. Vent gasses from several flora are perpetrator for growing extra than 7% of the aggregate worldwide CO₂ technology mechanical fumes gasses incorporates up to 15% CO₂ (N. Abdel - Raouf, 2012). Concentrated on carbon dioxide expulsion from air by means of microalgae subtle in a layer photograph bioreactor. He determined that the photosynthetic CO₂ obsession changed into unequivocally difficulty to the gathering of CO₂ always gave amid the algal development. In mild of observe with the aid of (Cheng, 2006)) a system for cleansing a sullied air through the use of inexperienced boom development, for instance, Spirulina is match for lowering carbon dioxide (CO₂), nitrogen oxide (NO_x) and/or sulfur oxide (Sox) inside the dirtied air and creating oxygen. That is, this structure includes a preferred public tank stacked with a standard public fluid together with the green improvement, an air supply unit for convincing the polluted air into the way of life fluid to split carbon dioxide and nitrogen oxide and/or sulphur oxide within the lifestyle fluid, and a lights unit for

radiating a light to the lifestyle fluid. By exuding the mild to the life - style fluid within the vicinity of carbon dioxide, photosynthesis of the inexperienced improvement is raised to exchange over carbon dioxide into oxygen. Besides, the inexperienced development makes use of the nitrogen oxide and/or sulphur oxide as a supplement within the midst of the photosynthesis. In this way, the existing gadget can

appropriately refine the debased air to make a purifier air, that's wealthy in oxygen (BAGH). Prepared biopower's from green growth extraordinarily biodiesel. The quick advantage of green growth is growing step by step.

According to National Air Quality Standards, 2009. Air sample amassed must be as compared with the standard:

Table 1: Ambient air quality standard

Pollutant	Time Weighted	Concentration In Ambient Air		Methods of measurement
		Industrial Area	Residential Area Sensitive Area	
Sulphur Dioxide	Annual	80 $\mu\text{g}/\text{M}^3$	20	UV fluorescence
Nitrogen Dioxide	Annual	40	30	Chemiluminescence
Pm ₁₀	Annual	60	60	Gravimetric, beta attenuation
Ozone	8 Hours	100	100	UV photometric, chemiluminescence
Lead	Annual	0.5	0.5	XRF using Teflon filter
Carbon Monoxide	8 Hours	2	2	IR spectroscopy

(Source: Central Pollution Control Board, 2006)

Following code of safety of hydrogen sulphide, it is highly hazardous. It can cause fire and explosion

Table 2: Code of safety of hydrogen sulphide

S. No	Concentration (Ppm)	Effects	Measures
1	10	Eye irritations if exposed more than 4 hours	Maximum Permissible limit
2	50 - 250	Eye irritations, respiratory and lungs problem	Protective measures require
3	100 - 400	Highly risky, Possible death	Protection needed to avoid death
4	500 - 1000	Immediate unconsciousness	- do -

(Source: IS 15200 - 2002 code of safety)

Causes: Factors Responsible for Air Pollution

Air pollutants can end result from every human and natural moves. Natural events that pollute the air embody forest fires, volcanic eruptions, wind erosion, pollen dispersal, evaporation of natural compounds and natural radioactivity. Sources of air pollution speak to the various locations, activities or factors which might be accountable for the liberating of pollutants into the surroundings.

4. Consequences: Effects of Air Pollution

4.1 Health Effects

Air pollutants are a massive hazard component for a couple of health situations which consist of breathing infections, coronary heart disorder, and lung most cancers, consistent with the WHO. The fitness effects because of air pollutants may consist of issue in respiratory, wheezing, coughing, bronchial asthma and aggravation of present respiratory and cardiac conditions. These results can bring about expanded medicinal drug use, progressed physician or emergency room visits, more health centre admissions and untimely loss of life. The human health consequences of terrible air first rate are a protracted manner achieving, but basically have an impact on the frame's respiration machine and the cardiovascular system. Individual reactions to air pollutants rely upon the shape of pollutant someone is exposed to, the degree of publicity, the person's fitness repute and genetics.

4.2 Environmental Effects

Poisonous air pollutants (poisonous chemical substances inside the air) can form acid rain. It can also shape unstable ground lap ozone. These destroy trees, plants, farms,

animals and continue to make water our bodies dangerous to human beings and animals that stay and rely upon water.

4.3 Economic Effects

The impact of air pollutants at the financial system may be a derived one. In simple language, the economic device prospers whilst people are healthy and business company that relies upon on cultivated uncooked materials and natural assets are walking at whole overall performance. Air pollutants reduces agricultural crop and commercial forest yields with the resource of billions of cash every year. This similarly to human beings staying off paintings for health reasons can charges the economic system significantly.

5. Control: Measures to reduce Air Pollution

Solution efforts on pollution are usually a huge problem. This is why prevention interventions are continually a higher manner of controlling air pollution. These prevention strategies can either come from government (legal guidelines) or by individual movements. In many large cities, tracking equipment's has been established at many points within the city. Authorities read them often to check the quality of air

5.1 Government (or community) level prevention

- Governments at some points of the arena have already taken motion towards air pollutants with the aid of introducing green electricity. Some governments are investing in wind energy and solar electricity, as well as other renewable strength, to decrease burning of fossil fuels, which cause heavy air pollution.

- Governments are also forcing groups to be more responsible with their manufacturing activity
- Companies are also building more energy efficient cars, which pollute less than before.

5.2 Individual Level Prevention

- Encourage your own family to apply the bus, teach or motorcycle while commuting. If all of us do that, there could be fewer automobiles on street and less fumes.
- Use energy (mild, water, boiler, kettle and hearth woods) accurately. This is due to the fact lots of fossil fuels are burned to generate power, and so if we can reduce down the use, we can additionally cut down the quantity of pollution we create.
- Recycle and re - use things. This will minimize the dependence of producing new matters. Remember production industries create lots of pollution, so if we can re - use such things as buying plastic luggage, clothing, paper and bottles, it can assist.

5.2.1. Control devices

The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere.

- **Mechanical collectors** (dust cyclones, multi - cyclones)
- **Electrostatic precipitators:** An electrostatic precipitator (ESP) or electrostatic air cleanser is a particulate collection device that removes particles from a flowing gas (inclusive of air) the use of the force of an electric field. Electrostatic precipitators are surprisingly green filtration devices that minimally obstruct the go with the flow of gases via the tool, and may effortlessly cast - off fine particulates inclusive of dirt and smoke from the air circulate.
- **Bag houses:** Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter - cleaning system, and a dust receptacle or dust removal system (distinguished from air cleaners which utilize disposable filters to remove the dust).
- **Particulate scrubbers:** Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

5.2.2. Some Facts and Statistics about Air Pollution

- Air pollutants impacts children extra than adults due to higher concentrations of polluted air in their structures according to frame length.
- India is the country with the worst air first - rate in the global.
- The European Union would spend 161 billion Euros 12 months if deaths caused by air pollutants had been dwindled.
- In big towns, over eighty% of fatal pollution that reason lung harm come from vehicles, buses, bikes and different vehicles on the road.

- According to the World Health Organization, there are as many deaths (1.3 million in line with year) in the world because of air pollutants as there are deaths due to automobile accidents.
- The common person breathes 3, 000 gallons of air each day.
- The Great Smog of London in 1952 became one of the worst air pollution occasions in records with over 8, 000 deaths.
- The largest cause of air pollutants in Europe is avenue transportation with over 5, 000 humans' loss of life every year from lung cancer and heart attacks resulting from car exhaust fumes.

6. Conclusion

This record mainly makes a speciality of the reduction of pollution of air. Here it's far achieved by means of passing the pollutant gases to the system containing spirulina. The algae utilize the carbon dioxide, nitrogen dioxide and Sulphur dioxide as the vitamins for its increase. By the process of photosynthesis where carbon dioxide is transformed to oxygen making use of nitrogen dioxide and sulphur oxide as vitamins spirulina has reduced the pollutants. Through series of take a look at its far located that the amount of nitrogen dioxide, carbon dioxide and sulphur dioxide has been reduced. From this it is clean that we've got numerous approaches of controlling air pollutants. The handiest aspect requires is to apply it beside the point form. This paper represents the special technologies which might be employed in various industries and the use of various fuels which can be imminent for the solution of air pollutants. Air pollutants entails spate of pollution which creates a whole lot of chronic and acute diseases in individual so we ought to position the foreign particles within the constraint of standard restrict. The awareness of hydrogen sulphide gas produced become 24.81 ppm which was in toxic range (IS 15200 - 2002) and for this reason, an attempt has been made to reduce its concentration inside permissible restriction after passing via filter out mattress. The 2d clear out bed with more thickness has been found to be more efficient in eliminating hydrogen sulphide fuel. It showed that when filter out mattress is having more extent it could eliminate better. So, relying upon the required awareness, length of clear out mattress may be numerous and can be used broadly. Algae whilst incorporated in filter out bed the efficiency further increases.

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