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Review on Foam Stability with Surfactant and Nanoparticles

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ABSTRACT

This review article focuses on the foam stability with surface active agents like surfactant and nanoparticles (NPs). The results found from this study, foam was generated by static and dynamic method. NPs were adsorbed at the interface of air-water and increase the foam stability. Concentration of surfactant was also important for foam stability. Size of particle, temperature, concentration of surfactant, pH were affect the foam stability. Foam was thermodynamically unstable. Properties of foam were checked by different methods i.e. sedimentation test, NP-CO_2 foam stability test, displacement tests, surface tension measurements, microscopic image analysis, foam texture analysis, zeta potential measurement, etc. Application of foam used in different industries like oil industry, waste water, food and dairy industries etc.

KEYWORDS

Foam, Foam stability, Nanoparticles, Surfactant, Surface tension.

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1. INTRODUCTION

Foam is the dispersion of gas in liquid (surfactant) [1]. The main factors in foam stability are drainage, coarsening, and bubble coalescence. Coarsening means growth of average size of bubble. Foam behavior is vary by the diffusion of gas through the lamellae of liquid, which affects the bubble size due to the pressure difference created by gas. When the lamella was collapsed, it started a coalescence of gas bubbles [2]. Surfactants and nanoparticles (NPs) are commonly used by researchers and industrialists to improve the foam stability. Surfactant used as a foaming agent could be added in between gas-liquid films, which helps to decrease the interfacial tension and energy between the gas-liquid films leads to stabilize the dispersed system [3]. Applications of aqueous foams are in our daily lives, such as firefighting, mineral flotation, detergents, and also insulation, metal foam *etc*. Recently, the petroleum industry has used foam for improving oil production, a mixture of gases

applied for foam stability and direct utilization of flue gas (mixture of N_2, CO_2, and NOx's) for reducing the cost of CO_2 gas separation in the industry [1-2]. A common example is sea foam. When aqueous systems are agitated, it trap the air in a liquid film to form foam, but the film is not stable for long time. Long-lasting foams are formed due to the presence of stabilizing agents, *e.g.* dissolved organic carbon from decomposed organisms, which increased the stability of foam. Generally, from the point of view of industrial or natural surfactants, foam is the best indicator [4]. NPs have recently been used to improve foam stability in food industry [5], forth flotation [6], EOR [7, 8]. In the foam film, NPs were adsorbed between the gas-liquid film, which increased the interface elasticity of the film and slowed down the bubble coarsening due to the adsorption rate and its dilational elasticity [9, 10]. Adsorption of NPs in the film reduced foam film thinning [11, 12]. Ravera *et al.,* 2008 [13] studied the silica NPs dispersion with various amounts of cationic surfactant, *i.e.* CTAB. Because of surfactant adsorption, surface particles became more hydrophobic as the CTAB surfactant concentration was increased [14]. This review article discusses the content of various additives such as surfactants, nanoparticles, and others used to improve foam stability.

2. FOAM STABILITY BY ADDITIVES

Foams were stabilized using different additives like surfactant, NPs, protein, *etc.* and in various ways, such as (1) foam film increases due to elasticity, (2) drainage of foam in the lamellae is reduced, (3) gas diffusion rate across the lamellae is decreases (4) surface and film viscosity increases in the film of foam [15].

2.1. Nanoparticles for Foam Stability

Silica NPs potential to enhance the foam stability of nonionic surfactants, and the concentration of surfactant, NPs were important parameters for foam stability and foam generation. NPs produced a more stable foam as compared to a fixed concentration of surfactant. The characteristics of foam were measured by its foam half-life, bubble size, and mobility tests. When the solid particle concentration increased, it might have a negative impact on foam stability [16]. The interaction of silica concentration and surfactant on drainage and ostwald ripening improved foamability and stability [17]. NPs in a water-liquid paraffin emulsion on equilibrium surface tension at different temperatures, as well as surface tension measurements used for bubble morphology and fluorescence microscopy [18]. Three different types of surfactant, sodium dodecyl sulfate (SDS), cetyl trimethyl ammonium bromide (CTAB) and polysorbate 80 (Tween 80) were used for foam generation by passing CO_2 gas and ionic surfactants had better foam life as compared to nonionic surfactant [19]. Surface behavior changed when silica particles were added to anionic SDS, and higher concentrations of SDS increased surface activity in the presence of NPs [20]. All NPs (SiO_2, Al_2O_3, TiO_2, and CuO) had higher NPs-CO_2-foam stability at 0.008 wt%, and foam half-lives were longer for SiO_2 NPs compared to other NPs [21]. The

stability of CO_2 foam in the presence of silica, nano-clay an Alpha-Olefin Sulfonate (AOS)-Lauramido Propyl Betaine (LAPB) surfactant were studied using bulk foam tests a micro fluidic device for experiments. It increased the viscosity, gave excellent foamability and stability [22]. The interactions of aqueous foam and solid particles in hydrocarbon reservoirs for foam stability revealed that calcium carbonate, barium sulfate, and strontium sulphate particles have higher thermodynamic stability than iron oxide and calcium sulphate particles [23]. SiO_2 NPs (partially hydrophobic) in the presence of SDS increased the foam stability, and SiO_2 NPs showed a synergetic effect on foam stability with SDS at appropriate concentrations [24]. Solid particles (silica and sepiolite fibres) size affected foam formation and stability. Sepiolite fibres were increased the lifetime of foam than the silica spheres [25]. Surfactant and particles interaction at interface of air and water and founded that more foam stability at low-to-moderate concentrations of surfactant than pure particle systems [26].

2.2. Surfactant for Foam Stability

The dynamic foam behavior of the surfactant Tween-20 in air–water and CO_2–water systems was compared. The foam height in the CO_2–water system was less than that in the air–water system, but the foam stability was better in the CO_2–water system [27]. M. J. Hofmann *et al.,* 2017 [28] studied the aqueous mixtures of SDS and high purity NaCl with respect to their equilibrium and dynamic surface tensions at a constant mean ionic activity. S. Alzobaidi *et al.,* 2017 [29] demonstrated that C/W foams stabilized with a single zwitterionic surfactant at a concentration of 1 %(w/v) in DI water and salinity and foam quality/up to 0.98 at 120 °C. M. A. Q. Siddiqui *et al.,* 2017 [30] performed the foam flooding experiments using fluoro surfactant FS-51 and alpha-olefin-sulfonate (AOS) and added different proportions of N_2 to sc-CO_2-foam on stability and structure of CO_2/N_2 with surfactants and revealed better strength in foam with N_2 above supercritical conditions of CO_2. M. J. Hofmann *et al.,* 2017 [31] studied the anionic surfactant sodium decyl sulfate (SDS) at below critical micellar concentration (cmc) at the interface of air–water and determined the equilibrium surface tension using a pendant drop tensiometer. J. Wang *et al.,* 2016 [32] studied the collapse of standing aqueous foams stabilized by SDS, using DOH and NaCl and found that viscoelasticity and foam stability increased because of the presence of DOH in the SDS solutions and decreased due to the weakened repulsive interactions between the two interfaces of the liquid films. K. Osei-Bonsu *et al.,* 2015 [33] investigated the foam stability of surfactants at the bulk and bubble scales in the absence and presence of isoparaffins, with less foam stability found in the presence of oil. M. Simjoo *et al.,* 2013 [34] studied the foamability and foam stability in the presence and in the of absence alkane-type oils with surfactants and nitrogen gas and founded that AOS revealed the good foam stability in the presence of oil. X. Dong *et al.,* 2010 [35] evaluated the foamability and foam stability of silica particles (hydrophilic) and cetyl trimethyl ammonium bromide (CTAB) dispersion in the presence and absence of liquid paraffin and found that the foamability and foam

stability of silica particles /CTAB dispersion decreased in the presence of liquid paraffin at low surfactant concentrations and increased at intermediate surfactant concentrations in the absence of liquid paraffin. B. Bai *et al.,* 2010 [36] investigated the kinetics and equilibrium of a CO_2 foaming agent on berea sandstone, as well as the effect of adsorption on foam stability. **Table-1** showed the different surfactants and NPs used by researchers for foam stability.

Table-1. Different surfactants and NPs used by researchers for foam stability.

Sr. No.	Surfactant	NPs	Gas	Other Chemicals	Methods/Characterization	Ref.
1	Pluronic F68	-	Air, CO_2, N_2	Milk protein, Perfluorohexane,	Study of drainage	[3]
2	Polyoxyethylene-(23)-lauryl ether, Brij L-23 natural surfactant	Silica particles	Air	-	Zeta potential, rheological measurements, preparation of the gels and foams.	[17]
3	SDBS	SiO_2 (15 nm)	Air	PEG-600 and PEG-1000 polymer	Foam tests, surface properties of emulsions and microscopic image analysis.	[18]
4	Sodium dodecyl sulfate, cetyltrimethylammonim bromide and Polysorbate 80	Alumina (99.9%) zirconium oxide (99.5%), calcium carbonate (98%), boron nitride (99%) and silica (99%)	CO_2	Diethanolamine (DEA), sodium metaborate	Surface tension measurement and foam properties studies.	[19]
5	Sodium Dodecyl Sulfate (≥99%)	Silica NPs	Air		Preparation of surfactant-nanoparticle dispersions, dynamic surface tension	[20]

	and Hexadecyl trimethylammonium bromide (≥99%)				and drop surface perturbation, foamability and foam stability.	
6	-	SiO_2 (40 nm), Al_2O_3(40nm), TiO_2 (40 nm), CuO (40 nm)	CO_2	-	Preparation of NPs-CO_2 foam, comparison of NPs-CO_2 foams at optimum NPs concentrations, sedimentation test, NP-CO_2 foam stability test, displacement tests.	[21]
7	Alpha-Olefin Sulfonate, SDS, Lauramidopropyl Betaine (LAPB) 35% active	Silica T30 NPs	CO_2	NaCl	DLS, bulk fluid test and microfluidic test.	[22]
8	Alpha Olefin Sulfonate	Calcium Carbonate, Calcium Sulfate, Barium Sulfate, Strontium Sulfate, Iron oxide	CO_2	-	Bulk foam texture and foam lifetime.	[23]
9	SDS (purity 99.0%)	Partially hydrophobic SiO_2 nanoparticle (14 nm)	N_2	Ethanol	SiO_2/SDS dispersion preparation, zeta potential of SiO_2/SDS dispersion, foam generated from SiO_2/SDS dispersion, surface tension and interfacial dilational rheology, sandpack experiments.	[24]

10	Triton X-100	Silica (300nm, Hydrodyn-amic dia.)	Air	Acetone,1-Octanol	Esterification & dispersion of particle and wafer surfaces, Estimation of contact angle changes with surfactant, Surface tension & adsorption studies, Measurement of foam stability & particle partitioning, Measurement of surface-pressure isotherms, Interfacial elasticity studies	[26]
11	Sodium dodecyl sulfate (SDS) (≥99.0%, Merck) (6 mmol L^{-1})	-	Air	NaCl	Surface tension, foam column and foam lamella stability, oscillating bubble.	[28]
12	Oleylamidopropyl dimethyl betaine, erucylamidopropyl dimethyl betaine, (cocoamidopropyl dimethyl betaine, (CAPB)	-	CO_2	KCl, NaCl, $CaCl_2$-$2H_2O$, HCl	Cloud point determination, high pressure interfacial tension measurements, aqueous phase rheology measurement, C/W foam formation and apparent viscosity measurements, determination of C/W foam morphology and stability.	[29]
13	SDS and DOH	-	Air	NaCl	Measurements of foam collapse, dynamic surface tension, surface viscoelasticity and surface (zeta) potential of air bubbles in surfactant sol.	[32]
14	Cocamidopropyl betaine	-	Air	-	Bulk-scale foam stability, bubble-scale foam stability and image	[33]

	(Cocobetaine), sodium dodecyl sulphate (SDS), Triton X100				analysis.	
15	AOS, Petrostep SB, Dowfax 8390, Enordet	-	N_2	Normal hexane, normal decane, normal hexadecane, red dye (oil red O, Sigma–Aldrich)	Foam column experiments, surface and interfacial tensions.	[34]
16	Cationic surfactant cetyltrimethyl ammonium bromide	Aerosil 200 silica nanoparticle	Air	Oil red O, Auramine O, rhodamine B	Preparation of A200 nanoparticle dispersion & A200/CTAB dispersion, Foam preparation & foam properties test, Oil/water & air/water interface tension measurement, Surface dilatational rheology theory & measurement, Macroscopic & microscopic image analysis, Zeta potential measurement	[35]

3. METHODOLOGY

3.1. Sedimentation Test

The sedimentation test was determined by the deposition of Al_2O_3, CuO, TiO_2 and SiO_2 NPs in DIW, and the optimum concentration of suspension NPs was prepared by agitating at 220 rpm using an orbital shaker for one hour. The measured pH values of prepared NPs were 6.70±0.1, 6.25±0.1, 6.35±0.1, and 6.60±0.1, respectively. Deposition of NPs was recorded for 1 h in 2 minute interval using a

UV-Vis spectrophotometer in the range of 200-800 nm at a maximum wavelength of 300 nm for calibration [21].

3.2. NP-CO_2 Foam Stability Test

Determine the bulk and bubble scale stability of prepared NPs-CO_2 foams. On the bubble scale, the half-life time was measured at the time of NPs-CO_2 generation. HD digital camera was used to capture the photo of foams decaying till the half-life time. Separate NPs-CO_2 foams were injected into the cubic Hele-Shaw cell, which has dimensions of 15 cm×15 cm×0.3 cm in length, width, and height, and a digital LEICA microscope was used to measure the foam bubble size; this was used in the bubble scale [21].

3.3. Displacement Tests

A quartz-sand sample was applied as porous media, shifted through 125 and 175 µm stainless steel sieves had average collector diameter of 150 µm. To remove impurities, the sample was cleaned with 12 N HCl acid and soaked for 24 hours. It was then washed in de-ionized water and baked at 250 °C for 12 hours. The density of the quartz-sand sample was 2.52 g/cm^3, measured after pretreatment using the standard method of ASTM [21].

3.4. Surface Tension Measurements

Surface tensions of solutions were measured by a K12 processor tensiometer with a wilhelmy plate [37].

3.5. Foam Texture Analysis

Foam generator fluids were surfactants. CO_2 and N_2 pass through a porous filter medium. Before entering the core, generated foam was passed through the visual cell. The image of the generated foam was captured using an HD camera, which analyzed the circularity of the bubbles. Circularity of the foam bubble is given by equation-1

$$Circularity = \frac{4\times\pi\times A}{Perimeter^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where A is the area of the bubble. When circularity was 1, the bubbles are in circular shape and when it was 0, the bubbles are polyhedral in shape [38].

3.6. Zeta Potential Measurement

The zeta potential value of AOS and AOS-guar solutions in the presence of NPs (SiO_2 or Fe_2O_3) at 25 °C was determined by the phase-analysis light-scattering (PALS) technique [39].

3.7. Microscopic Image Analysis

This analysis was used for the study of foam properties, adsorbed NPs and droplets of emulsion (Oil/water Interface) foaminess [18].

3.8. Physical Characterization of Particles

Scanning electron microscopy measurements were used for the sepiolite sample (platinum coated). Surface of sample was scanned with electron beam and also measured the pore size distribution of sample with mercury porosimetry using an AutoPore IV 9500 Instrument [25].

3.9. Particle Contact Angle Measurement

Washburn method measured the water contact angle on the surface of sepiolite and silica particles. It was based on the rate of penetration of wetting liquid into a packed bed of particles. Contact angle measurement was carried out in small glass tube (15 mm ID) which had taken in 2 g of solid particles, and whose bottom was closed off with a glass porous disc and connected to a computer for data collection of mass versus time [25].

4. TECHNICAL ASPECTS

4.1. Surface Tension

Qian sun *et al.,* 2015[24] studied the dynamic surface tension of dispersed NPs to see if have any effect on surface tension. Firstly, surface tension was slowly increased up to 70 mN/m. As compared to SiO_2 NPs, ethanol molecules spread easily to the surface. SiO_2 NPs were adsorbed with an ethanol molecule and diffused to the surface, which slightly reduced the surface tension at the equilibrium point. Detachment energy was high because of NPs adsorption became irreversible and was not replaced by ethanol. The surface tension of dispersion solution of SiO_2/SDS was less than SDS solution at the low surfactant concentration and addition of excess amount of SDS produced high surface tension without SiO_2. Surface tension was more due to the adsorption of SDS on SiO_2 NPs through hydrophobic interaction, left the hydrophilic head group in liquid and depletion at air–water interface [38, 26]. Surface tension effects of NPs: (1) Surface tension increases as the amount of SDS at the surface decreases due to adsorption on silica NPs, and (2) solid particle attachment at the dispersed surface tends to decrease surface tension [39].

4.2.Foam Half-Life

Foam behavior with respect to time for nonionic 1 surfactant with 0.25, 0.50, 0.75, and 1.00 wt% NPs were examined. At low and high concentrations of NPs were not able to improve the foam stability of a nonionic 1 surfactant. The optimum concentration was between 0.5 and 0.75 wt%. Nonionic 3 surfactant with NPs concentrations (0.25, 0.5 and 0.75 wt %) produced more stable foam for measurements of foam height. At this concentration, 0.25 wt% NPs with surfactant

gave better results than 1 wt% NPs. Foam decay was faster in surfactant solutions without NPs. Half-lives of foam were 28 h and 29 h, observed at 0.5 and 0.75 wt% NPs. Foam half-lives were greatest for nonionic 2 surfactants at 0.25 and 0.50 wt% NPs, 20 h [16].

4.3.Foam Stability

Qian sun *et al.,* 2015[24] found that the foam stability increases first and then decreases with surfactant concentration, and prepared the stable foam at 0.05 wt% SDS concentration. Dispersion viscosity was directly proportional to foam stability. Steric effects are formed at the bubble layer by NPs, which retard its shrinkage [40, 41]. When the particle surface charge is reduced, it can decrease the electrical barrier between the particles and the interface [42,43]. EI-Genk *et al.,* 1998[44] studied the particle adsorptions at the air–water interface, which were controlled by particle–interface and particle–particle interactions. SiO_2 NPs (Partially Hydrophobic) had positive charges and 30 mV of zeta potential. The zeta potential decreased as SDS concentration increased, eventually reaching zero at 0.05 wt% SDS.

4.4.Foam Behavior of SiO_2/SDS Dispersion

Bubbles coalesced due to the weak bond between the layers because of the adsorption of surfactant molecules at the interface of air-water for SDS foam. The bubble size of SDS solution was larger than of SiO_2/SDS dispersion at the same time. The size of the bubble in SiO_2/SDS foams initially decreased, then increased as the concentration of SDS increased. At the proper SDS concentration, adsorbed NPs on the film form a dense surface layer, which can also be maintained by changing the pressure [45]. Foam was stabilized by surfactant (SDS) at high concentrations of SDS, bubble size tends to increase with bubble coalescence.

4.5. Fluorescence Microscopy Imaging

A. Srivastava *et al.,* 2017 [18] used an inverted fluorescence microscope to investigate the microstructure of foam with stability over time at temperatures ranging from 20 to 60 °C. S. Zhang *et al.,* 2008 [46] observed that to decrease the coalescence of bubbles due to the adsorption of particles on the bubble surfaces, develop the dense films around the bubbles. Particle concentration decreased, which tends to lower the adsorption rate on the bubble surface [47]. A polymer compound having a long chain leads to solidifying S-NP adsorption layers, and the possible opposite effects are bubble generation and bubble coalescence. Polymers play critical roles as foam stabilizers and antifoam particles.

5. APPLICATION

In waste water, bacteria and viruses act as a colloidal particle and form the stabilized foam, but in some other cases, insoluble precipitates (hydrolysed cations) were present in the water and could be adsorbed between the interface of air and water surface, which causes foaming in waste water. Stabilized foams were also seen in the

food and dairy industries *e.g.* bread, beer *etc.* In the oil industry, foams were produced in boilers and different stages of distillation operations and asphaltene particles to stabilize the foam. Dispersed particles in the liquid pulp were attached to the bubble, which tends to separate particle from mineral in the froth flotation process [6].

6. CONCLUSION

The addition of additives such as surfactant, polymer, particle, and so on improved foam stability. These were adsorbed at the interface of gas-liquid and decreased the bubble rupturing. Drainage, coarsening, and bubble coalescence were the main factors required to control the foam stability. Bubble coarsening was inhibited or slowed down because of dilational elasticity. Gas was transfer from small and large size of bubble due to the pressure difference between the bubbles. The NPs were adsorbed at the interface of air–liquid because of their adsorption rate, which increased the interface elasticity. Some methodologies for the analysis of foam stability were sedimentation tests, NP-CO_2 foam stability test, displacement tests, surface tension measurements, microscopic image analysis, foam texture analysis, zeta potential measurement *etc*. Foams were used for different purposes in the oil industry such as enhanced oil recovery and particle separation from minerals in the froth flotation process.

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Wastewater Treatment by using Activated Charcoal obtained from Fruit Peels: A Review

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ABSTRACT

Activated carbon is also called activated coal or activated charcoal which could be produced by the activation of any carbonaceous material such as agricultural wastes like coconut shells, wood chips, sawdust, paddy husks, etc. In recent years various types of fruit peels are also used as raw material for the preparation of activated carbon. Activated carbon is a widely used adsorbent for the separation of dissolved pollutants from the effluent, due to its high porosity and providing a large surface area to adsorb contaminants. This paper reviews various techniques for the preparation of activated carbon as a low-cost adsorbent from various kinds of fruit peels with the help of recent investigations.

KEYWORDS

Activated carbon, Adsorbent, Carbonaceous material, Effluent, Fruit peels, Pollutants.

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1. INTRODUCTION

Activated carbon is the carbon produced from the carbonaceous source material. Activated carbon can be generated from many different sources and constructed in varying production processes. The physical properties and performance characteristics of the resulting carbon depend upon the raw materials used, the activation process, and process parameters. Several researchers have reported on activated carbons from agricultural wastes. Agricultural wastes are palm shells, fruit shells, fruit peels, groundnut shells, coconut shells, etc. This low-cost activated carbon may contribute to environmental sustainability and offer benefits for future commercial applications [1, 2, 3]. Clean-water scarcity is becoming a global concern, particularly with the fast development of the Earth's inhabitants and the constant climate deterioration. This development and the intensifying anthropogenic activities such as frequent deforestation and improvised industrialization signify the main reasons behind the worldwide water crisis.

The growing use of colorants in food and beverages industries, cosmetics, textiles, plastics, the paper also pharmaceutical has reached perturbing levels. Dyes

are one of the remarkable water contaminants. Even traces of dyes (as low as 1 ppm) can highly affect a significant volume of water, an issue that consequently increases the magnitude of the problem by affecting aquatic creatures and human health. Statistics show that approximately 106 tons of dyes are consumed worldwide per year and the quantity of dyes discharged into water sources represents 2% of this amount [4].

1.1 Historical Background

In ancient times (1500 B.C) activated charcoal has been used for medicinal purposes. Then in 1773 adsorption of activated carbon was discovered 1773 by the Swedish chemist Karl Wilhelm Scheele [1].

Carbon material was prepared to purify potable water by Lipscombe in 1862. This development covered the way for the money-oriented applications of activated carbon, first for potable water and then in the wastewater sector. The excellent gas adsorption properties of carbons derived from coconut shells were discovered by Hunter in 1865. The term 'adsorption' was first introduced to describe the uptake of gases by carbons by Kayser in 1881.

At the beginning of the twentieth century activated carbon was first produced on an industrial scale, especially during the First World War. At that time activated carbon was only available in the form of powdered (PAC). The basic concepts of chemical and thermal (or physical) activation of carbon were covered by the Swedish chemist von Ostreijko by obtaining two patents, in 1900 and 1901.

Activated charcoal was produced commercially when granular activated charcoal was used in gas masks, solvent recovery, and air purification. Activated carbon prepared from coconut shells was developed in 1914-1918 due to the First World War and the introduction of poisonous gas was affecting respiration in the military. In 1928 Chicago meat packers used activated carbon in the form of PAC for taste and odor control for the first time. It was observed that the first application of activated carbon in the form of GAC was in the year 1910 for the dechlorination of chlorinated water in England. In 1929 the first GAC filters were introduced in Germany and the USA in 1930 for taste and odor removal.

Today, different types of activated carbon exist in the market, with the most capitalistically common ones being powdered activated charcoal (PAC), and granular activated charcoal (GAC). The unique properties of activated charcoal are conferred on it mainly utilizing its high porosity.

2. METHODS FOR THE PREPARATION OF ACTIVATED CHARCOAL

It can be produced (activated) by using the following processes:

2.1. Physical Activation

The source material is expanded into activated carbon using hot gases. Air is then introduced to burn out the gasses, creating a graded, screened, and de-dredge form of activated carbon. This is normally done by using one or more of the following processes:

Carbonization: Material with carbon content is incinerated at temperatures in the range of 600–900°C, usually in an inert atmosphere with gases such as argon or nitrogen.

Activation/oxidation: Raw substance or carbonized material is unveiled to oxidizing atmospheres (oxygen or steam) at temperatures above 250°C, normally in the temperature range of 600–1200°C [5].

2.2. Chemical Activation

The carbon material is impregnated with certain chemicals. The chemical is generally an acid, strong base, or a salt (phosphoric acid 25%, potassium hydroxide5%, sodium hydroxide 5%, calcium chloride 25%, zinc chloride 25%, sodium hydroxide 5%). The carbon is then conquered to high temperatures (250–600 °C). It has adhered that the temperature activates the carbon at this stage by forcing the material to open up and have more microscopic pores. Chemical activation is preferred to physical activation owing to the lower temperatures, better quality consistency, and shorter time needed for activating the material [6].

2.3. Characterization Techniques

Some techniques used to identify the properties of the material are as follows:

2.3.1. Scanning Electron Microscopy (SEM) Analysis

Scanning electron microscopy (SEM) analyses the surfaces of materials, particles, and fibers so that the best information may be measured and accessed thru image analysis. SEM provides a way for the industry to determine contamination issues, examine component failure, discover unknown particulates or study the contact between substances and their substrates. It can also provide a means of information to support the research of materials, chemicals, or biological samples [7,8].

2.3.2. Fourier Transform Infrared Radiation (FTIR) Analysis

It is an analytical technique used to classify organic, polymeric, and, in some cases, inorganic materials. The FTIR analysis technique uses infrared light to inspect test samples and observe chemical properties [9].

For e.g. The FTIR result of pomelo peel-activated charcoal [10].

2.3.3. Biological Oxygen Demand (BOD) Analysis

It is the amount of dissolved oxygen (DO) consume by microorganisms for the decomposition of organic matter under aerobic conditions. Testing for BOD involves

incubating a sealed water sample at 20°C for five days, followed by measuring the difference in oxygen content before and after incubation [11].

2.3.4. Chemical Oxygen Demand (COD) Analysis

It is the amounts of dissolved oxygen (DO) consume for the oxidation of organic matter and inorganic compounds such as ammonia or nitrite under controlled conditions. COD testing typically contains digestion of the water sample in a sealed vial with potassium dichromate and sulfuric acid at 150°C for 2 hours. The small glass container read in a spectrophotometer to determine the results [11].

For e.g. The BOD and COD result from activated sludge, sand filters, and activated carbon as shown in **Table-1** [12].

Table-1. BOD and COD analysis.

Parameters	Concentration treated water	Maximum permissible limits
BOD (mg /l)	3.03	3-4
COD (mg/l)	10.20	30-45
Total suspended solids (mg /l)	2.70	1050
Total dissolved solids. TDS (mg /l)	401.33	450

2.3.5. Heavy Metal Analysis

By using Atomic Absorption Spectroscopy heavy metal levels were determined. The results obtained show that the mean values of all Heavy Metals (with exception of Hg) in water samples collected from different places were analyzed [13].

3. REVIEW OF WORK DONE

Researchers have studied the production of activated carbon from various types of fruit peels as a raw material**.**

Xie et al. (2014) prepared activated charcoal from orange peels (Citrus sinensis) – The raw material was collected from fruit sellers. This was dried and crushed by sieving through a 60-mesh sieve. Then the orange peels were immersed into 100ml

$ZnCl_2$ solution for 36hr. The sample was centrifuged from the solution and dried. Then added coal tar and mixed it with samples. The samples were then the partial size of 5-8mm was formed by extrusion. The material was taken at 300°C continuously to carbonize for 30min and cleaned with 10% HCL and deionized water successively then drying had done at 105°C. The active carbon for biological wastewater treatment or follow-up processing requires abundant mesopore and good biophilia ability, the surface area, and porosity were found to be 1477 m2/g and 2.0 nm-4.0 nm. This orange peel active carbon is used for the exhibited enhanced ability to adsorb fulvic acids in leachate biochemical water. This research has a deep positive influence on effectively controlling water pollution, improving area water quality, easing orange peel waste pollution, and promoting coordinated development among society, the economy, and the environment

Rosli et al (2015) carried out prepared activated charcoal from jackfruit peels – Jackfruit peels were collected from the market. The raw material was crushed into small pieces, for 24hr, and ground into granular sizes. Then precursors were impregnated with chemical agents (85% Orthophosphoric acid) before the carbonization process take place by heating the impregnated precursor by ramping the temperature from room temperature to 800°C heating rate 10°C/min for 3hr via nitrogen gas. The material was used for adsorption which has a surface area of 257.798 m^2/g and a pore volume of 0.77cm^2/g. Jackfruit Peel Activated Carbon is used for the adsorption of lead [14].

Yamuna and Kamaraj (2016) carried out prepared activated charcoal from pineapple peel – The pineapple peel waste was collected from fruit sellers. The collected raw material was cut into small pieces and sun-dried. The material was completely mixed with H_2SO_4 in the 1:1 and maintained in a muffle furnace at 300°C for 3hr for activation. The material was taken out and washed with distilled water till pH reached 7. It was then sieved for the particle size of 150-250mm and then stored in plastic containers. It was used for the actual elimination of methylene blue dye from an aqueous solution. The consequence of the adsorbent was considered by agitating at 220rpm 50ml of 40ppm of dye solutions with different doses of the adsorbent (25-200mg) for a greater than the equilibrium time. Pineapple peel waste activated carbon as an adsorbent for the effective removal of methylene blue dye from an aqueous solution **[**15].

Turoti and Qgundana (2017) carried out prepared activated charcoal from watermelon rind (Citrullus lanatus) – The watermelon rind were purchased from a local market. The material was washed and reduced into small pieces and dried under a shade of 24hr. at 70°C. The carbonization was done by using a muffle furnace at 500°C for 5 mins. Then the material passed for the activation process and the activation agent was Na_2CO_3 at varying concentrations of, 0.01M, 0.025 to 1.00M. The mixture was introduced into a muffle furnace at 700°C for activation times of

5mins and 10mins separately after the washing had been done. The produced product was used for the adsorption of methylene blue dye from an aqueous solution using Na_2CO_3-activated watermelon rind. The adsorption intensity (n=3.935), capacity (Kf=7.05). Adsorption of Methylene blue dye from an Aqueous solution was carried out effectively by using Sodium Carbonate Activated Citrullus lanatus (Watermelon) Rind.

Sinto et al (2018) prepared activated charcoal from banana peels – the raw material used to divide into two parts, carbonized at a furnace without a stream of N_2 gas and other with N_2 gas set at 0.15NL/min. This process was carried out at 300°C for 1hr. where the sieve size was 30-mesh. Both types of carbon were broken into four parts and were immersed in an H_2SO_4 solution where the concentration tested was 3ml of H_2SO_4 for each 1 g carbon used. Then the material was heated at 85°C for 1hr. after that pH neutralization was done for activated charcoal. The prepared material was used as an adsorbent for motor vehicle exhaust emissions which have a charcoal surface are 450-500 m^2. This activated carbon of banana peel waste was used as an adsorbent for motor vehicle exhaust emissions [16].

Wedad et al (2021) prepared activated charcoal from pomegranate peel – Date pit and pomegranate peel wastes were collected from the local market. Both the materials were washed and dried in an open-air oven at 105°C for 24hr. After reaching constant weight were crushed and ground in a mill to a fine powder and then sieved by the particle size of <120mm. The activation was done by using H_3PO_4 (60%) and $ZnCl_2$ (50%) at a ratio of 1:1 by volume for 24hr to chemically activate them. Then the mixture was dried in an oven at 105°C. Finally, carbonization was performed in a muffle furnace at 500°C for 60-70min in the absence of air, further characterization was done. This activated carbon was used for the removal of cadmium and lead ions from an aqueous solution, having a surface area of 1354 m^2/g. Using pomegranate peel and date pit activated carbon for the removal of cadmium and lead ions from an aqueous solution [17].

Zheng and Yuling (2021) prepared activated charcoal from pomelo peels – Pomelo peels were collected from a local fruit shop. The peels were dried in the sun naturally, followed by drying at 90°C for 24hr. then the material was ashed to 75-180 mm. preparation process of pomelo-activated charcoal primarily includes carbonization and activation. In carbonization, the material was put in a tubular stove with N_2 flow at 550°C for 2hr. then the material was impregnated with K_2CO_3 at the different mass ratios for 2R and then the mixture was put on a stove for activation at different activation temperatures. After the characterization was done the material was used as a high-performance adsorbent for the removal of Cu (II), which is having surface area 771-1006 m^2/g. The resulting activated charcoal was used for the adsorption of Cu(II) from aqueous solutions in the batch mode and yielded a superior adsorption capacity of 139.08 mg/g [18].

4. CONCLUSION

From this review, it is an affirmation that fruit peels are very useful to prepare the Activated Carbon. AC prepared from fruit peels is effectively used in the treatment of wastewater for the removal of pollutants to reduce the extent of environmental pollution. Potentially, these can be applied to full-scale wastewater treatment, therefore the global demand for activated charcoal is expected to continue rising in the coming years.

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Abbreviations

AC - Activated Carbon/Charcoal
PAC - Powdered Activated Carbon
GAC - Granular Activated Carbon
SEM - Scanning Electron Microscopy
FTIR - Fourier Transform Infrared Spectroscopy
BOD - Biological Oxygen Demand
COD - Chemical Oxygen Demand
DO - Dissolved Oxygen

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Strategy of Zero Liquid Discharge to Mitigate Water Pollution: Indian Scenario

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ABSTRACT
Industrialization is essential for a country's economic growth. An increase in industrial development has elevated water consumption and is leading to the depletion of water resources. On the other hand, water pollution will become a major issue in the future. So, the importance is to seek out another path in terms of value-effective and reliability to treat wastewater by using Three R's Strategy to Reduce, Reuse, and Recycle the treated water has become a necessity. The Zero Liquid Discharge Strategy is the future of reducing the problem of wastewater by complete recycling of water by eliminating liquid waste. This strategy aims to reduce waste generation from the water sector industries by increasing the feed water to the industry. This paper reviews various ZLD technologies that are possible for multiple industrial sectors and, a few innovative technologies in this wastewater will be saved and recycled at supply resources.

KEYWORDS
Depletion, Innovative Technologies, Pollution, Value-effective, Zero Liquid Discharge.

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1. INTRODUCTION

Industrial development and increasing urbanization acquire various types of habitable things which include water, food, shelter, etc.; but large consumption of water, mainly freshwater, makes worldwide problems. Nation-to-nation analysis shows that developed countries use more water than developing countries for their industrial use 1. This untreated wastewater from plants creates an adverse effect on human health and the environment. The alternative is ZLD, within which concentrate is treated to supply product water and essentially dry salts. Consequently, liquid waste is not discharged. Currently, ZLD desalination is applied primarily to industrial waste streams and powerhouse cooling water [2] ZLD technologies are thermal desalination and evaporation ponds, each of which has disadvantages that will make its use prohibitively expensive for portable applications.

1.1 Indian and other Nations Industrial Problems

This strategy was created to remove any effluent waste that comes from the industry by recycling water for reuse in industry purposes [3]. Due to high capital investment and major work inputs, this project has less attention and fewer active plants worldwide because of different quality gaps consisting of effluent water of industry and non-potable reused water of industry [4]. This industrial effluent water contains various kinds of organic and inorganic pollutants at higher concentrations. Those can be removed by applying some treatments like coagulation and some biological process that decontaminates the effluent water. But for making reusable water or recreational water or treated water, we required some advanced treatment that can also fulfill the requirements of ZLD [2,5]. In India, some large-scale industries are using the ZLD strategy, and some other industries use traditional methods or they directly send the effluent to the water sources which leads to the disturbance of COD, BOD, and TOC. Due to the non-subsidized circular of government, less awareness of the strategy, and high capital expenditure, this strategy in India has seen less [6]. Continuous innovation, research, and development in electrochemical and membrane-based processes provide low-cost expenditure of ZLD and at low input cost. RO process makes the effluent water pure but the membrane of this process consumes more expenditure and this membrane required continuous maintenance [7]. The large demand in the chemical and petrochemical industries is one of the most important factors driving ZLD market growth.

From the analysis of the ZLD strategy, this study points toward reducing the challenges that come with the deployment of this system and highlights the major process and instruments used in this for sustainable development [3].

2. ZLD SYSTEM

It is a system consisting of preliminary unit processes or units of operations or a combination of the water treatment units, within which there's zero discharge of liquid effluent from industry, process plant, etc. It indicates there's no liquid discharge since the effluent is effectively treated and sent for reusing in industry or for recycling. Now for the effective treatment of wastewater, we are required to utilize many technologies together which mainly support Membrane, Evaporator, or Multi-effect Evaporator systems. [4]

Industry comes to the point that ZLD must be in the form of: -

1. It should eliminate the entire wastewater stream from the running plants.
2. It should obey the three R’s Technique.

2.1 Legislation related to the ZLD in India

The legislation associated with ZLD in India as given by Saha [8]

1. Between 1992 – 2002 Supreme Court directed polluting pharmaceutical plants near Hyderabad to pay Rs 4000/acre annually to prevent the loss of soil fertility.
2. Province tribunal order mandated ZLD for dyeing, bleaching units, tanneries, and distilleries. (2006).
3. State Supreme Court order mandated ZLD for 12 large pharmaceutical units around Hyderabad discharging 25,000 kLD. (2008)
4. Tamil Nadu Government and Central Government Scheme for a subsidy of Rs. 320 crores (interest-free loan) to line up ZLDs within the state following the writ of 2006. (2010)
5. Punjab Pollution panel mandated ZLD in 8 large electroplating industries in Ludhiana (2010).
6. Punjab Pollution instrument panel assisted 500+ small electroplating units in Ludhiana to line up a CETP with ZLD. (2010)
7. Rajasthan Government declared a Capital Subsidy on ZLD-based ETP up to 20% of the amount paid to the trader for the treatment plant excluding civil works, subject to a maximum of Rs. 1.0 Crore (2014).

3. EFFLUENT ANALYSIS OF FEED WATER OF ZLD

For effective working and proper output from the ZLD system, it is necessary to check first BOD, COD of the feed, and mainly component TOC which plays a vital role in organic recovery. But for the ZLD every industry possesses a different range of BOD, COD

E.g.

1. The pharma Industry waste water possesses overall 34.8 and 48.6% of BOD and COD [9].
2. Paint Industry waste water possesses an overall BOD between 475 to 2400 mg/l and COD between 1100-3800 mg/l.
3. From Distilleries it varies from 40,000–50,000 mg/l of BOD and 80,000–100,000 mg/l of COD [10].
4. Overall, Textile Industries COD varies from 1600 to 3200 mg/l and BOD is between 500 to 1010 mg/l [11].
5. From Fertilizer Industry, by NEQS range, COD and BOD are 400mg/l and 200mg/l.

3.1 Treatments used in the ZLD System

The main aim of ZLD is to remove useful waste like salt and required bacteria and recover maximum useful Water.

ZLD System consists of the following Techniques:-

1. Preliminary Treatment
i) Separation
ii) gravitational
iii) Filtration
2. Primary Treatment
i) Sedimentation
ii) Equalization
iii) Neutralization
3. Secondary Treatment
i) Aerobic
ii) Anaerobic

Now Main Treatment process comes here

4. Tertiary Treatment
i) Chlorination
ii) Multi-Stage Reverse osmosis
iii) Chemical Oxidation
iv) Electro-dialysis
v) Ultra-Filtration
vi) Evaporator
vii) Brine Concentrators
viii) Crystallizer

3.2 Technologies used in the ZLD System

For this above treatment we can use the following instrument they are [6]:

1. Membrane Bio-Reactor Technology (MBR)
2. Ultra-Filtration (UF)
3. Reverse Osmosis (RO)
4. Evaporator Or Multi Effect Evaporator
5. Incinerator
6. Agitated Thin Film Dryer (ATFD)

3.2.1 Use of MBR in ZLD

It is used as a biological secondary treatment for the reduction of organic load. Degradation of biomass occurs inside the bioreactor tank, while separation of treated wastewater from microorganisms is completed in an exceedingly membrane module [6].

By using this in the system we didn't require a Secondary clarifier.

3.2.2 Use of Ultra Filtration (UF) in ZLD

It is used for the removal of colloidal matter, bacteria, and viruses. It is used as a pre-treatment for RO. It is useful to remove suspended, colloidal particles, bacteria, and viruses [12].

3.2.3 Use of RO in ZLD

It is used for the removal of salinity (TDS) and residual organics by passing wastewater through the semi-permeable membrane by applying high pressure. It is useful in terms of clean technology and no handling of chemicals like acid/alkali like ion exchange technology and this permeates water free of ions and can be used in industrial processes [13].

3.2.4 Use of Multi-Effect Evaporator in ZLD

It is used to vaporize the wastewater by passing the heat from steam; it separates the salt and water contents. It is mainly used to separate salts, which is a common effluent that occurs in wastewater.

3.2.5 Use of Agitated Thin Film Dryer in ZLD

It is used to dry high TDS water or products using a fast-revolving rotor in a heating jacket. It has gentle evaporation and a high evaporation rate. One passes Evaporation.

3.2.6 Use of Incinerator in ZLD

It is used for burning concentrated effluent by thermal energy. It is a useful method for very high strength (High COD) effluent which is difficult to biodegrade. No further treatment is required.

3.2.7 Use of Crystallizer in ZLD

It is used to boil off any remaining liquid, leaving you with a dry, solid cake for disposal

4. DESALINATION OF WATER FROM ZLD

Reverse osmosis (RO) is a water purification method that uses a partial membrane to forget ions, unwanted molecules, and bigger particles from potable. Reverse osmosis differs from filtration, in this; the mechanism of fluid flow is by osmosis across a membrane [12]. From the RO we can desalinate the wastewater. The feed of ZLD at tertiary treatment is treated by UF/RO dual process to decrease the turbidity of water and recover water up to 75% and by mixing the advanced technology of High-efficiency RO with it, we can achieve up to 95% of water recovery [1]. Mechanical vapor compression (MVC) is usually employed in thermal concentrators and crystallizers. The process of RO in ZLD has an operating salinity range of 70-75 g/L

for driving hydraulic pressure limitations. And Electro dialysis/Electro dialysis reversal (ED/EDR) process and forward osmosis (FO) is used to minimize the salinity difference between the RO effluent feed in ZLD [2, 9].

4.1. Declination of Organic Pollutants in ZLD

Declination of organic pollutants is a key factor of the ZLD system in which we reduce the organic pollutant by using this strategy, where the total dissolved solids (TDS) and high hardness of wastewater are different in different industries, but by balancing these factors we can reduce these pollutants [12]. Nowadays the wastewater from domestic use and industrial use is sent to the biological treatment plant before the ZLD system, but sometimes feed comes with a high amount concentration of the organic recovery and before that recovery of biological treatment must be there[13]. By getting the example of the coal industry, the effluent water contains carbon or organic waste up to 60-65% of total wastewater. By using this system, we can reduce organic waste by up to 90-95% of total carbon waste in the coal industry [10]Now involves the most point is that the preliminary step for the ZLD system should be carried out with it the biological treatment system

5. PROBLEMS, FACTORS, AND NEED FOR ADVANCED RESEARCH IN THE ZLD

5.1 Is the Cost of Capital and Plant Setup too High?

I. First of all the pretreatment process or units in ZLD are not expensive or the same as that of wastewater treatment, but the advanced treatment is expensive such as UF/RO [14]

II. Capital cost for the ZLD varies on the treatment process, the location of plant availability of effluent, and fluctuation of water quality [10,11,15]

III. Required expenditure for ZLD in treatment contains in percentage is– [16,17]

- Capital cost – 5% of the total cost
- Preliminary treatment – 5% of the total cost
- Primary treatment – 10% of the total cost
- Secondary treatment – 20% of the total cost
- Tertiary or Advanced treatment – 60% of the total cost

So from the above data, it is concluded that the required capital cost is $1/20^{th}$ of the overall treatment

I. Selecting suitable techniques according to the quantum of effluent and its characteristics.

II. Increased operational cost and finances on the plant and its global, national & regional competitiveness [8].

III. Development of a high and effective recovery system to recover greater than 95% of wastewater 1.

Figure-1 shows the typical basic process of ZLD system in the industry.

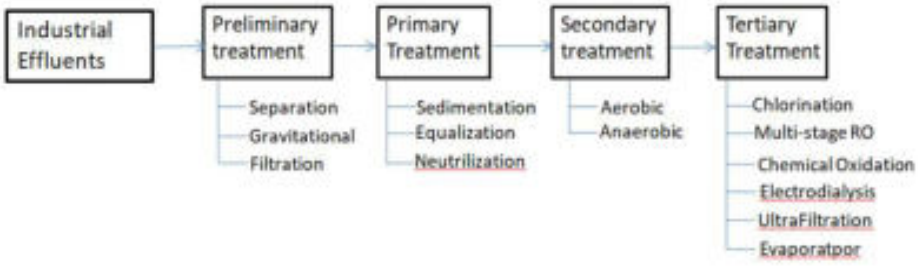

Figure-1. Typical basic process of ZLD system in the industry.

5.2 Factors Affect the ZLD Most

i) ZLD system, irrespective of its high cost may be an economical solution for minimizing the cost of the transportation of waste in large quantities for longer distances.

ii) Feeding water for the ZLD from conventional sources comes at a high cost. For this, we can use recycled water. It required a high cost to install one plant, due to this attention to this system is less? Awareness of this ZLD system is much less[2,8,14,15]

5.3 Need for Advanced Research*:*

Now a day's innovation is the key factor that reduces the expenditure of the ZLD system.

i) Therefore to reduce the cost of advanced treatment we required research and development cells on that which is RO, UF, and evaporator

ii)Another set of minds is based on incinerator **[**2,15]

6. SECTOR-WISE ZLD

It can be successful in India

1. In Distillery, ZLD can be achieved by using Bio-Methanation which can be followed by using RO and incineration as the main components [10].

2. In Pharmaceutical feed water for the ZLD consists of high and low COD, and TDS due to this, ZLD will be achievable by using the all-treatment process with an activated carbon process for stabilizing the range of COD and TDS.
3. In Textiles, ZLD can be achievable by using all primary to advanced technology in addition we are required to use instruments such as sand filtration, and micro-filtration for removing large colloidal particles [6,18].
4. In Fertilizers, ZLD may be achieved by using the chemical treatment, RO because of some toxic compounds [2, 19]

7. CASE STUDY

7.1 In Haryana: one water technology sector offers this system. This system is helping to recover more than 95% of effluent water that comes from industry and some amount of brine is generated, which can be treated further.

They use:

1. Clarifier to precipitate out metals, hardness, and silica.
2. Filter press to concentrate secondary solid waste after pre-treatment or alongside an evaporator.
3. Ultrafiltration (UF) to remove all the leftover trace amounts of suspended solids and prevent fouling, scaling, and/or corrosion down the line of treatment.
4. Reverse osmosis (RO) to remove the bulk of dissolved solids from the water stream in the primary phases of concentration.
5. Brine concentrators to further concentrate the reject RO stream or reject from electro dialysis to further reduce waste volume.
6. Evaporator for vaporizing access water in the final phases of waste concentration before crystallizer.
7. Crystallizer to leave you with a dry, solid cake for disposal.

In Textile Manufacturing as per the Government Rules and norms, some textile plants are deploying these zero liquid discharge (ZLD) systems to recover 95-98% effluent waters for reuse purposes.

By using
1. Precipitation
2. coagulation and flocculation
3. Biological oxidation
4. Membrane filtration
5. Reverse osmosis
6. Advanced chemical oxidation

8. CONCLUSION

This review that concept of Zero liquid discharge is a potential solution to mitigate the problem of water pollution. Also, it will conserve water through its reusage.

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Leachate Treatment Using Horizontal Flow Constructed Wetland

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ABSTRACT
Leachate from an embankment varies mostly in type relying on the age of the landfill and the form of debris it consists of. Both suspended and disintegrating fabric are frequently gift. Precipitation soaking thru backfill-stored trash is the number one source of leachate. Once in contact with the rotting garbage, the permeating greater water becomes poisoned, and at that point, it tends to seep out from the waste materials as leachate. Households, marketplaces, boardinghouses, cafeterias, and clinical facilities are the principle manufacturers of strong waste in Kolhapur City. Therefore, kinds of 185 MT of strong trash are produced each day in Kolhapur city. The breakdown of the strong waste causes leachate to gather below the strong waste because of the Municipal solid waste (MSW) being disposed of in the zoom web site at Kasbabawda. Leachate will occur if the solid waste is not treated speedy. Depending at the form of wastewater, wetland structures use regular capability plant life, soil, and animal to treat wastewater. This study will help us to investigate the detail study of leachate treatment using horizontal flow constructed wetland process.

KEYWORDS
Debris, Leachate, MSW, Marketplaces, Boardinghouses, Cafeterias and clinical facilities

…….

1. INTRODUCTION

Leachate is a result gotten from metropolitan strong waste on account of its physical, concoction and organic changes and would be created in high quality and harmfulness landfills, incinerators, preparing plants and reusing offices. Leachate as a rule contains an assortment of unsafe toxins, substantial metals, alkali nitrogen mixes, and different parts which are more entangled than civil wastewater. Leachate as a rule contains an assortment of unsafe poisons, substantial metals, smelling salts nitrogen mixes, and different segments which are more convoluted than civil wastewater. The formation of the leachate is associated to such factors, including the characteristics of the waste, the destination, the seasons, the time and structures of the landfills, the retention time at the incinerator, the method of operation of the landfill sites, etc. Among all reasons for leachate, landfill leachate is of greatest concern. Up to 95% of total municipal solid waste (MSW) collected world- wide are disposed using the landfills [1].

After treatment with layer bioreactors and a pivot osmosis system, the concentrated liquid will be pumped into the radiator to harden and change the structures of fly flotsam and jetsam. Landfill leachate characteristics were varying depending on the operation type and the age of the landfill [2]. The amount and quality of leachate produced in the dump is strongly dependent on the trash components and deluge, which may be anticipated using a few models. Toxic metals including Cd, Cr, Cu, Pb, Ni, Zn, and Hg, as well other harmful natural issues, may be scattered among various particles of varied sizes. The leachate and concentrated liquid from the pivot absorption test, for example, contain salts of Cl, Br, F, NO3, HCO3-, and SO42-. Micronuclei generated via unload in metropolis In vivo leachate in mouse bone middle gadgets may be utilised to portray leachate's poisonous properties. Even at moderate ranges of toxicity, like as 5 mg/L COD, the reed may be harmed via leachate. Leachate need to account for little extra than 20% - 30% of daily misfortunes supposed for landfill, which can be predicted with the proper algorithms. Subsurface water will seep into the waste mass after the covering system is removed, increasing the quantity of leachate. With effective junk pile management, the amount of leachate generated may be dramatically decreased. The landfill leachates are capable of producing severe environmental impacts especially in vulnerable recipients such as aquifers and surface waters [3].

Landfill leachate is an important pollution factor resulting from municipal landfill sites [4]. The most generally perceived treatment techniques for leachate are natural and physicochemical strategies, which have the differential clearing limits with respect to various poisons. The effluents must satisfy the release guidelines or reuse inside burning plants with no release into the earth.

1.1 Constructed Wetland

The polluted rainwater creates potential threat to the environment [5]. To control overflow of municipal or current wastewater, greywater, or stormwater, fictional wetland is created. It also can be used to recover land that has been mined or reduce the loss of herbal zones due to development. Development wetlands are man-made facilities that clear out wastewater using herbal capacity plants, soil, and creatures. The architecture of developing wetlands ought to be balanced depending on the form of wastewater. Each concentrated and n location where there is a tremendous amount of suspended particles or natural solvent has been treated with a developed wetland (estimated COD and BOD), correspondingly to normal wetland, built wetland moreover go about as bio filter and can dispose of a change of contamination, (for example, organic matter, supplement microbe expulsion, but instead, have been intended to eliminate distinctive water good fixing, for example, suspended solids, characteristic check and nutrient. All types of pathogen are anticipated to be elimination than surface wetland.

Municipal leachate was treated in an experimental unit of constructed wetlands of subsurface flow type [6]. There are two significant sorts of created wetland underground stream and floor drift fabricate wetland the planted vegetation plays out an essential function in sullied evacuation. The channel bed, comprising regularly of sand and rock, has a similarly significant capacity to play some created wetland may likewise moreover fill in as propensity for local and transient natural life, however that isn't their main role. Subsurface skim manufactured wetland is intended to have both level float or vertical progression of water through the rock and sandy bottom. Vertical waft system has similar area requirement than parallel flow system. Leachate, home wastewater, and business drain water are all handled in created wetlands. The evolved wetland is a low-effort answer with low development and minimum investment.

The main advantages of such systems are low cost of construction and low energy and labor for operation [7]. CW is appropriately should be plan by and large there are two kinds of built wetlands vertical stream developed wetland and even stream developed wetland the two wetlands have same cycle however they are structure extraordinary. Horizontal Flow Wetland is subsurface, and it utilize rising aquatic vegetation.in the vertical Flow Wetland the soil is used for vegetation to support the roots of emergent plants. Usually, wetland is constructed by excavating or filling, involving water control structure to establish desired HLR.

1.2 Horizontal Flow Constructed Wetland

The flat subsurface stream built wetland is an enormous rock and sand fill bowl that is planted with wetland vegetation as wastewater stream evenly through the bowl. The materials sift through particles and microorganisms debase the organics. In flat stream wetland the channel media is utilized for eliminating solids which go about as channel in model after that the gushing is passed to root zoning measure where the plants establishes assume significant part in look after porousness.

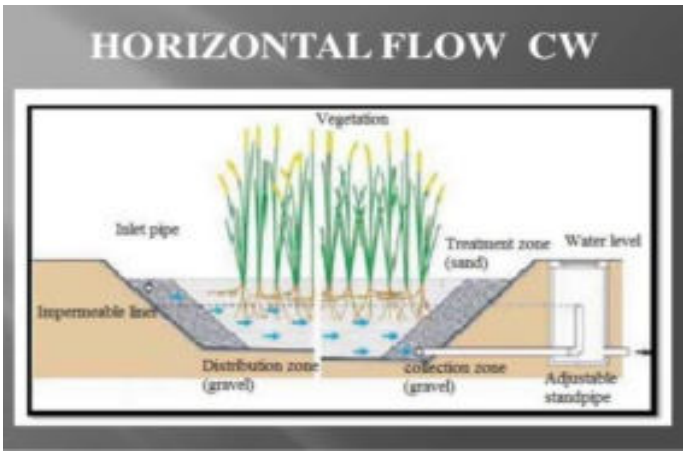

Figure-1. Typical Schematic chart of Horizontal subsurface stream-built wetland.

Plan of developed wetland relies upon the how much the gushing is going to included and which amount of wastewater is there so that to choose way and compartment in model, before including emanating it ought to be permitted to settle so obstructing won't happen (see **Figure-1**).

1.3 Advantages of Horizontal Subsurface Flow Constructed Wetland

It is a low-cost biological remedy process

High decrease of BOD, Suspended solids and microorganisms

No electrical vitality is required

Low operational and maintenance cost

Can be fabricated and fixed with locally accessible materials

No chemicals required

1.4 Disadvantages of Horizontal Subsurface Flow Constructed Wetland

Required large land area

Long Maturity period to work at full capacity

Little nutrient removal

2. STUDY AREA

2.1 Kolhapur Municipal Solid Waste Management (Zoom Site), Kasaba Bawda

It is assessed that the absolute amount of MSW (Municipal Solid Waste) produced in Kolhapur city is about 185MT (Metric Tons) every day which means more than 300gm per capita/day. Out of the complete produced, about 180MT of MSW is gathered every day in Kolhapur city through a compelling framework built up by KMC. Of this, around 150MT of waste is straightforwardly dumped at the open dumping spread across 8 sections of land site at Kasaba Bawda which is inside as far as possible. The dry and wet strong squanders are gathered from singular houses and open residue receptacles and moved to Kasaba Bawda where it is dumped at Zoom Fertilizer venture.

The strong waste assortment and transport is done according to time table and assortment course is fixed by the partnership. The waste dumped at zoom venture is handled to change over it into natural compost. The strong waste assortment and transport work in done regular day from morning 6 to 12 toward the evening. Kolhapur was selected for source to collect the leachate from zoom site where the leachate is generated due to huge solid waste dumped in zoom site. The pretreated leachate is collected from zoom site for the treatment of leachate using constructed wetland (see **Figure-2**).

Figure-2. Collection of leachate in MSW site Kasba Bawda.

2.2 Dilution of Leachate by using Domestic Wastewater

The leachate is highly toxic in nature therefore we cannot treat leachate directly and it will be affected on the plants also. Therefore, domestic wastewater was used for dilution of leachate. The domestic wastewater was collected from Shastrinagar nallah, Shastrinagar, Kolhapur.

3. METHODOLOGY

Because the leachate is so hazardous, we're not able to deal with it at once without also harming the flowers. As a result, leachate became diluted the use of residential wastewater. The Shastrinagar nallah at Shastrinagar, Kolhapur, served because the source for the residential wastewater collection.

3.1 Proposed Research Methodology

Collection of Leachate from the site.

Determination of characteristics of leachate.

Sampling of domestic wastewater and laboratory analysis.

Evaluation of Proportion of Leachate and wastewater for dilution.

Design of model constructed wetland for treatment.

Treatment of leachate and determination of parameters of effluent.

Results and conclusion

3.2 Development of Pilot Scale Horizontal Flow Constructed Wetland

A parallel subsurface stream advanced wetland is a large rock and sand-stuffed bowl with wetland herbage planted inner. As wastewater flows via the bowl at a degree

aircraft, the channel fabric channels out debris and microbes degrade the organic. The pilot scale model of horizontall flow constructed wetland was designed as per below steps:

Step 1: Excavation for construction of Model from the literature study of the horizontal flow constructed wetland, to developed the pilot scale model of it, excavation size is designed such as, Length = 1.65m, Width = 0.91m, Depth = 0.30m as shown in below (see **Figure-3**).

Figure-3. Step 1 of pilot scale model of horizontal flow constructed wetland.

Figure-4. Step 2 of pilot scale model of horizontal flow constructed wetland.

Step 2 - Plastic cover is used for inner lining so that the wetland will not come in contact with soil or surface level. The whole wetland was divided into three parts, the first part was the filter media which was connected to the part of the constructed wetland which was in middle and the third part was the outlet (see **Figure-4**).

Step 3 - The first compartment was of filter media with the first layer of gravels at the bottom, 20 to 40 mm size gravels was used and the layer is 12 cm. Gravel is used as a substrate, since it provides a large surface area for biochemical processes. Provides high conductivity needed to stabilize wetland hydraulic retention time (see **Figure-5**).

Figure-5. Step 3 of pilot scale model of horizontal flow constructed wetland.

Figure-6. Step 4 of pilot scale model of horizontal flow constructed wetland.

Step 4 - The first compartment was filter media in which second layer used was blast furnace slag. Modern waste, for example, impact heater slag, with receptive Fe/Al hydroxy and $CaCO_3$ adsorption surfaces, has been effectively utilized as dynamic channel materials for P expulsion on pilot scale or full-scale wetlands/channels size furnace slag used in media was 20-40 mm and 12 cm depth were provided (see **Figure-6**).

Step 5- Sand was used in the upper layer filter media. It requires excellent permeability required to restore wetland retention time. Sand is assumed to become the most suitable substrate for hydraulic and organic load capacity. The size of the sand used throughout the filter was 2 mm-4.75 mm (see **Figure-7**).

Figure-7. Step 5 of pilot scale model of horizontal flow constructed wetland.

Step 6 - This was the final working model of horizontal constructed wetland (see **Figure-8**).

Figure-8. Step 6 of pilot scale model of horizontal flow constructed wetland.

3.3 Operation of Pilot Scale Horizontal Flow Constructed Wetland

The pilot scale constructed wetland consist of horizontal flow constructed wetland. The dimension of the model is 1.65 m *0.91m *0.34m in which there are three compartments. First compartment is filtration zone, second compartment is root zoning, third compartment is collection zone.

Filtration zone – From the tank the influent enters into filtration zone. Where filter media consist of gravel, sand and blast furnace slag. This media act as a filter to remove solids and suspended materials which float on influent. Infiltration zone microorganism degrade the organics. After filtration of influent inters into next compartment.

Plants zone- In this compartment the filtered wastewater enters into plant zone. Where colocasia plant is used as wetland species. The plant are used to remove heavy metals, nutrients, and helps to reduce BOD, COD and pH where played an important role in reducing the percentage of COD, BOD, pH Satisfactory results are found using colocasia as species in wetland.

Collection zone-This is last compartment of horizontal constructed wetland. Where the treated wastewater is collected for sampling purpose and after that oulet water is again allowed to pass through the same process from first. For recirculation treatment the oulet water is again allow to treat and then recirculated wastewater is taken through outlet for sampling.

3.4 Collection of Leachate

Figure-9. Leachate collection.

Kasba Bawda Kolhapur was selected for source to collect the leachate from zoom site where the leachate is generated due to huge solid waste dumped in zoom site. The

pretreated leachate is collected from zoom site for the treatment using horizontal flow constructed wetland (see **Figure-9**).

3.5 Sketch of Pilot Scale Model

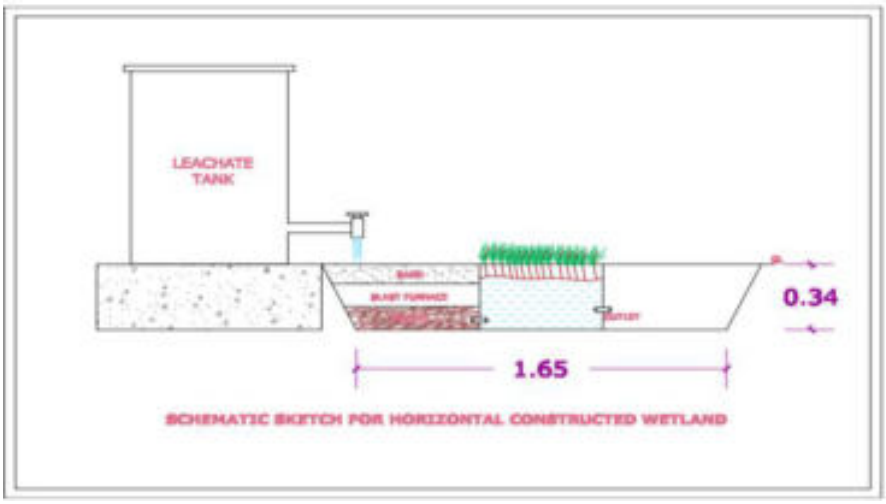

Figure-10. Schematic sketch of horizontal flow constructed wetland model.

Figure-10 shows the Schematic sketch of horizontal flow constructed wetland model.

3.6 General Leachate Characteristics

Table-1 gives the general characteristics of leachate.

Table-1. General characteristics of leachate.

Sr. No.	Details	Leachate
1	Colour	Dark black
2	Odour	Medium
3	pH	7.5-9
4	BOD (mg/l)	450-480
5	COD (mg/l)	13100-13480

4. RESULT AND DISCUSSION

4.1 Initial Analysis of Leachate

Table-2 provides initial analysis of leachate.

Table-2. Initial analysis of leachate.

Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5

	Date 12/07/19	Date 12/07/19	Date 12/07/19	Date 12/07/19	Date 12/07/19
pH	7.82	7.93	7.84	8.2	7.98
Colour	Dark black	Dark black	Dark black	Dark black	Dark black
Odour	Medium	Medium	Medium	Medium	Medium
BOD	294	232.5	259	320	289
COD	8080	7200	8299	7600	6593

4.2 Analysis of Sample

The dilution of leachate with domestic wastewater was taken in the ratio of 1:2:3, such as 70% wastewater and 30% leachate were used. From the laboratory testing following results were taken

Testing results without recirculation

4.3 pH Results Without Recirculation

Table-3. pH result without recirculation.

Sr. No.	Inlet (pH)	Outlet (pH)
1	8.90	7.86
2	8.23	7.52
3	8.50	7.20
4	7.96	7.30
5	8.45	8.05

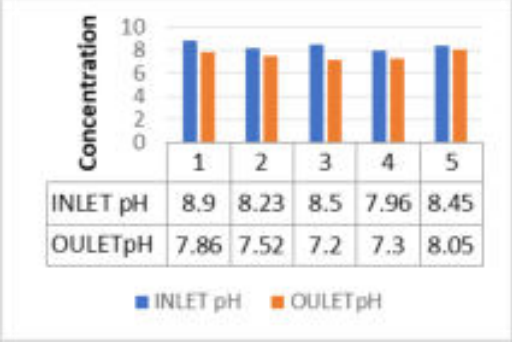

Figure-11. pH results without recirculation.

From **Table-3** it was observed that pH results of dilution 1:2:3 without recirculation. pH of inlet varies from 7.96 to 8.90 and outlet from 7.20 to 7.86. The average efficiency of pH removal is. The results showed the satisfactorily reduction. It was observed that effluent pH values are reduced than that of influent values of mixture of leachate and domestic wastewater (see **Figure-11**).

4.4 BOD Results Without Recirculation

Table-4. BOD result without recirculation.

Sr. No.	Inlet (BOD)	Outlet (BOD)	Efficiency
1	249	52	79.11
2	230	56	75.65
3	258	60	76.74
4	216	43	80.97
5	198	44	77.7

From **Table-4** it was observed that BOD results of dilution 1:2:3 without recirculation. BOD inlet varies from 198 to 258 and outlet from 43 to 60. The average efficiency of BOD removal is 89%. The results showed the satisfactorily reduction. It was seen that profluent BOD esteems are decreased than that of influent estimations of blend of leachate and home-grown waste water (see **Figure-12**).

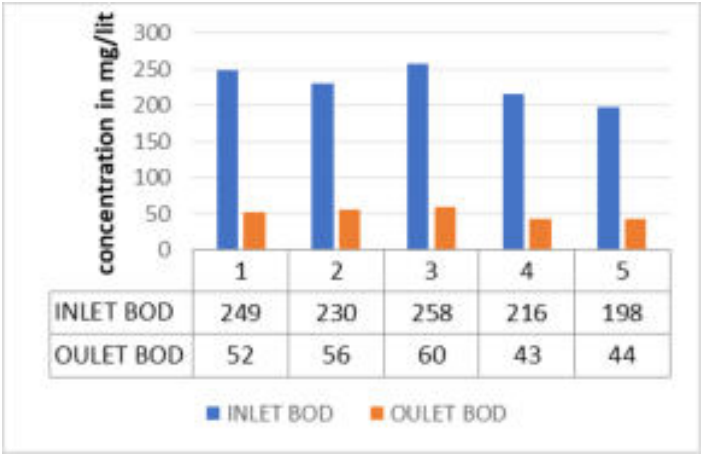

Figure-12. BOD results without recirculation.

4.5 COD Results Without Recirculation

Table-5. COD result without recirculation.

Sr. No.	Inlet (COD)	Outlet (COD)	Efficiency

1	1240	660	46.7
2	1210	621	48.6
3	1310	790	39.69
4	1160	689	40.51
5	1223	590	51.02

From **Table-5** it was observed that COD results of dilution 1:2:3 without recirculation. COD of inlet vary from 1160 to 1310 and outlet from 590 to 790. The average efficiency of COD removal is 45%.The results showed the satisfactorily reduction. It was observed that effluent B values are reduced than that of influent values of mixture of leachate and domestic waste water (see **Figure-13**).

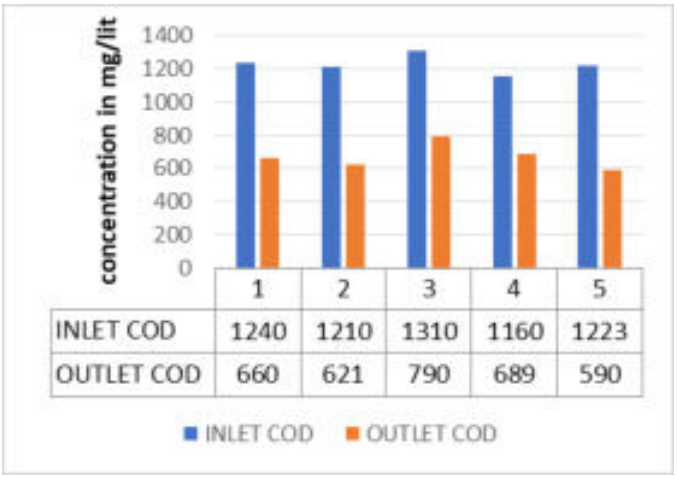

Figure-13. COD results without recirculation.

Testing results with recirculation

4.6 pH Results with Recirculation

Table-6. pH result with recirculation.

Sr. No.	Inlet (pH)	Outlet (pH)
1	7.52	7.10
2	7.30	6.90

From **Table-6** it was observed that pH results of dilution 1:2:3 with recirculation of inlet vary from 7.30 to7.52 and outlet from 6.90 to 7.10. The average efficiency of pH removal is 5.5%. The results showed the satisfactorily reduction. It was observed that effluent pH values are reduced than that of influent values of mixture of leachate and domestic wastewater (see **Figure-14**).

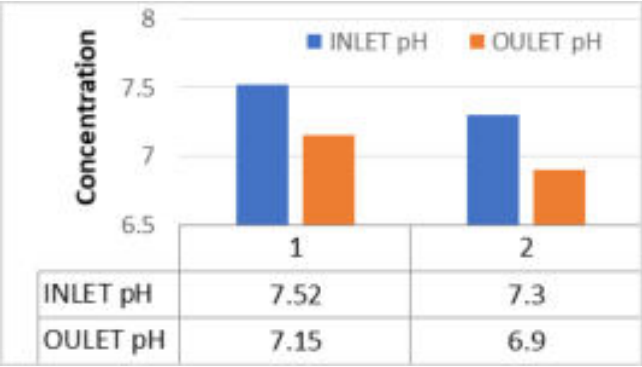

Figure-14. pH results with recirculation.

From the above consequences it is considered that COD and BOD effects are decreased significantly. Colocasia plant performed a integral position to reduce the BOD and COD. The instrument of oxygen evacuation where microbial corruption in the appended biofilm assumed predominant job which had indicated this quality of plant. The plant demonstration manage media for microbial defilement to take locale and for transport of oxygen to rhizosphere for high-sway biodegradation. Due to recirculation technique the BOD values are decreased much. The pH is also in limit after the treatment. The effluent can be discharge into irrigation. Due to use of blast furnace slag in filter media and recirculation method nice consequences are discover.

4.7 BOD Results with Recirculation

Table-7. BOD result with recirculation.

	Inlet (BOD)	Outlet (BOD)	Efficiency	Efficiency in %
Recycle water	60	8	0.87	86.67
Recycle water	44	4	0.91	90.90

From **Table-7** it was observed that BOD results of dilution 1:2:3 with recirculation of inlet vary from 44 to 60 and outlet from 4 to 8. The average efficiency of BOD removal is 89%. The results showed the satisfactorily reduction using recirculation. It was looked that profluent BOD esteems are decreased than that of influent estimations of blend of leachate and homegrown wastewater (see **Figure-15**).

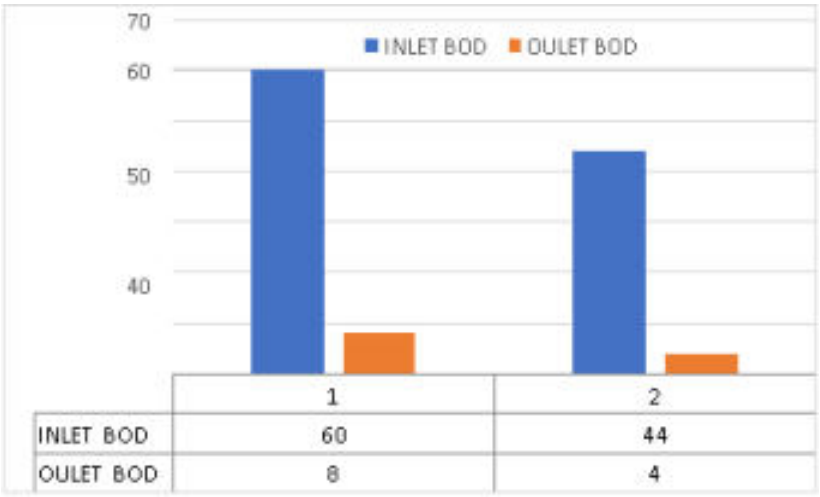

Figure-15. BOD results with recirculation.

4.8 COD Results with Recirculation

Table-8. COD result with recirculation.

	Inlet (COD)	Outlet (COD)	Efficiency	Efficiency in %
Recycle water	790	510	0.35	35.44
Recycle water	689	549	0.2	20.32

From **Table-8** it was observed that COD results of dilution 1:2:3 without recirculation of inlet vary from 689 to 790 and outlet from 510 to 549. The average efficiency of COD removal is 27%.The results showed the satisfactorily reduction using recirculation. It was observed that effluent COD values are reduced than that of influent values of mixture of leachate and domestic wastewater (see **Figure-16**).

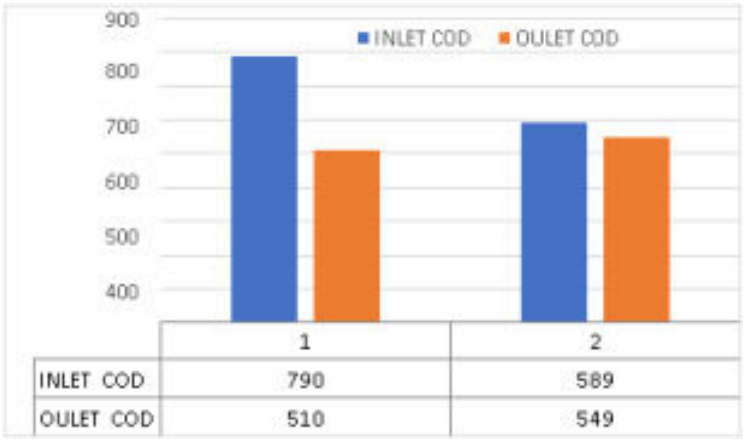

Figure-16. COD results with recirculation.

The recirculating process with blast furnace slag as filter material produce good results. Excluding recirculation, the mean COD and BOD reductions for concentration 1:2:3 were 45% and 80%, correspondingly. Typical COD and BOD reductions for dilution 1:2:3 with recirculation are 27% and 88%, accordingly. Regarding re-circulation, the median COD and BOD decreases for dilution 1:4 were 46% and 82%, respectively. For dilution 1:4, the mean COD and BOD reductions were found to be 38% and 65%, respectively, with re-circulation. For treating wastewater involving recirculation, 1:4 dilutions fared better than other dilutions. After re-circulation, 1:2:3 dilutions produced superior results for BOD.

5. CONCLUSION

Blast furnace slag may be utilised as filter out cloth within the first compartment for leachate treatment by way of horizontal float wetland. Results are higher than the ones of sand clear out. Blast furnace slag is a type of commercial waste that may be used as wetlands' clear out fabric. Regular unmarried treatment yields first rate results, however the effects are a great deal stepped forward via recirculating the cleaned wastewater. So, for progressed HFW performance, dealt with wastewater (leachate) may be recycled. Thus, HFW with blast furnace slag and handled wastewater recirculation proven to be superior than normal HFW.

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Simplified Rigid-Plastic Method for Seismic Design of Reinforced Concrete Frames: A review

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ABSTRACT
There are a number of methods currently in practice to evaluate seismic performance of Reinforced Concrete building frames. Out of which Response Spectra method, Time-History analysis and push-over analysis are quite popular among structural engineers. Most widely used method of response spectrum analysis is overtaken by Time-History analysis by the efficient computing system easily available these days. Non-linear time History analysis is still less preferred due to a large number of computations involved in it. In such type of analysis material non-linearity is considered during time-integration of the equations of motion. However, a simplified method is available in the literature; which takes into consideration the non-linearity of structural materials without involving many number of computations. This method titled as Rigid-Plastic Seismic Design (RPSD) method ignores the contribution of elastic deformations in dynamic equilibrium equations since their magnitudes are very negligible as compared to that of plastic deformations beyond elastic limit. In this paper, development of RPSD method is briefly presented along-with highlighting of its special features and applicability in structural engineering.

KEYWORDS
Response Spectra, Rigid Plastic, Time-History analysis, Rigid-Plastic Seismic Design, Non-linear time, History analysis.

…….

1. INTRODUCTION

When a structure is subjected to strong ground motions, it induces elastic as well as plastic stresses on the structure. Such structures are usually designed to yield practically. If we consider behaviour of Reinforced Concrete frame under such circumstances, introduction of plastic hinges for the plastic behaviour of the frame could be the simplified approach adopted. Such extreme conditions demands for the capacity to withstand large plastic displacements before collapse. During such situations, the elastic deformations developed in the structure can be compared as very small in magnitude to those plastic deformations developed at the critical locations of the structure. The more violent the earthquake, the greater the plastic

part of the displacement. It means that for strong earthquakes the elastic part of the displacement tends to be negligible and we can treat such behaviour of the structure as rigid-plastic. This simplified assumptions results in less computational intensive method for seismic analysis. Especially, for high intensity earthquake motions, this simplified method gives relatively acceptable solutions.

Seismic analysis of buildings, has gaining major importance in the design of multi-story buildings. Reported cases of building failure in all over the world in past couple of decades has real-time data and causes during seismic collapse. Ductility designed building frame is the necessity in the natural calamity of earthquake and during such hazard building should facilitate enough evacuation time for the occupants before final or partial collapse or can remain intact with its full strength. Underestimations of reserved strength due to inelastic behaviour directly affect the economy of the design and over estimation may lead to risk assessment for the life occupancy as well as in the cost of sub structure. Thus accurate estimation becomes very much important. In present practice, seismic analysis is mostly carried out using response spectrum method rather than carrying out Time-History analysis for mid-height buildings. Generalized response spectrum is used instead of site specific spectra. The recent developments in the code provisions gives emphasize on the non-linear analysis to study seismic behaviour. Also the newly developed construction materials has good amount of reserved strength beyond the elastic region. A large number of Time-History data is easily available. Increase in computational facilities makes it convenient to undertake non-linear analysis. To handle such issues numerical simulation plays major role in estimating seismic forces for safety and cost effective construction of the buildings. These force estimation plays major role in building design.

In order to calculate plastic displacements a non-linear analysis is needed. However, a simple rigid-plastic response spectrum can be constructed to calculate the maximum plastic displacement of the rigid-plastic oscillator. It eliminates the need for the non-linear analysis altogether and can be constructed easily. Such approach can be treated as upper bound to the maximum plastic displacement of any elastic-plastic oscillator under the given earthquake motion.

2. LITERATURE REVIEW

It has been widely accepted that it is neither economical nor necessary to design the reinforced concrete structures to withstand the effects of strong earthquake motion within elastic limits of the materials as mentioned by Nielsen [1]. Rather, it's quite practical to design for localized plastic behavior of the structures, where an approximate level of damage can be accepted, and remaining part, where no damage takes place behaves elastically. The regions where plastic behavior is supposed to

occur are plastic hinges. These are selected with respect to their ability to develop ductile behaviour and accessibility for repairing work post-earthquake event.

Paglietti and Porcu [2]. were the beginners who showed that the rigid-plastic oscillators can be used to evaluate the maximum plastic displacement of any elastic-plastic oscillator under any earthquake. They also introduced a rigid-plastic response spectrum, which provides an easy method to calculate the maximum plastic displacement of an elastic -plastic oscillator in seismic motion. Such a spectrum is easier to construct than the elastic-plastic response spectrum. They derived expression for calculating approximate maximum plastic displacement for a structure with time period less than 0.60 seconds.

Rigid Plastic Seismic Design Method initially proposed by Costa et al. [3]. is a simplified method for non-linear time-history analysis of structures. This method is based on plasticity theory. Dynamic response is evaluated mainly considering plastic deformations. The formulation and the computational algorithm for time-history analysis of single degree of freedom system behaving in rigid-plastic manner is presented. The effect of pinching as well as yielding is included in the formulation. Equations of motion for desired collapse mechanism of a multi-degree-of-freedom (MDOF) system is formulated. These equations are further used in the analysis of four-story RC framed structure.

Costa et al. [3] applied Rigid-plastic Seismic Design method for the design of a 12-storey reinforced concrete frame. The structure is treated as an assemblage of rigid-bodies and the only source of internal displacements is the onset of plastic behavior at plastic hinges and rigid behavior in the remaining part of the structure. Thus, rigid-plastic Multi-Degree-of-Freedom (MDOF) system is analyzed.

Non-Linear Time-History Analysis (NLTHA) is commonly accepted as the most suitable method to determine the seismic demand on structure designed to develop non-linear behavior when subjected to earthquake motion. The solution is determined by means of a numerical step-by-step integration procedure in the time domain. However, NLTHA is computationally intensive method and also requires a statistical study on the dynamic response to several accelerograms.

Costa et al. [3] proposed new seismic design procedure for seismic design for strong ground motion based on simplified NLTHA for Reinforced Concrete structures. The method titled as Rigid-Plastic Seismic Design (RPSD) method assumes systems expected to perform in the non-linear range and its theoretical background is based on the Theory of Plasticity. Firstly, a collapse mechanism is chosen and the corresponding stress field is made safe outside the plastic hinges. This allows determination of the required structural strength using a rigid-plastic response spectrum, which is characteristic of the ground motion. The maximum

strength demand at any point is dependent on the intensity of ground motion, which initiates demand for distribution of required strength throughout the structure.

Porcu and Carta [4] showed that a rigid-plastic model may also predict fairly accurate peak plastic response of quite flexible elastic-plastic oscillator during seismic conditions. It is also showed that this approximation is on conservative side for a natural period of the elasto-plastic oscillator within a particular range. This range is derived through a simple graphical procedure using the elastic response spectrum for a given value of the oscillator yield acceleration. They have also calculated the value of the time period above which the earthquake is no longer able to produce plastic yielding. In further addition, Porcu and Carta developed practical method to evaluate maximum plastic displacement of a structure when it is modelled as a rigid-plastic oscillator. For relatively high and low values of natural period for the equivalent elastic-plastic oscillator, the maximum plastic displacement showed good accuracy. However, the authors developed empirical equation for the required corrections of medium period oscillators. It has been observed to be always conservative estimation of the seismic ductility demand.

Malaga et al. [5] demonstrated applications of rigid-plastic models for the seismic assessment and design of steel buildings. New rigid-plastic models are developed for concentrically-braced frames and structural systems consisting of moment-resisting frames (MRF) coupled with braced systems. They showed that, the direct relationships that exists between peak displacement and plastic capacity of rigid-plastic oscillators can be used to define the level of seismic demand for a given performance target.

To ensure the reliability of a rigid-plastic method, this method is applied by Porcu and Carta [4] to hundreds of different elastic-plastic oscillators with more than thirty time-history records. For different values of yield acceleration, mean ratio of the predicted value and exact value of the displacement ductility demand is plotted as a function of time period of the oscillator. It has been observed that the rigid-plastic method shows conservative calculation of the inelastic displacement demand. Comparison of the rigid-plastic method is made with other approximate methods. Kanade et al. [6] discussed a procedure for the site specific rigid-plastic spectrum. They worked out expressions to calculate dynamic response of rigid-plastic oscillator. For a given specific time-history, rigid-plastic spectrum is developed and it is further used to evaluate seismic response of Four-story building discussed in Costa et al. [3].

In further developments, Lin et al. [7], proposed a simple design procedure for reinforced concrete frame, neglecting elastic component of displacements for calculated seismic response during strong ground motions. Based on the member properties a suitable collapse mechanism is chosen and the multi-storey system is

converted into an equivalent rigid-plastic oscillator. Ultimate resisting capacity of a structure is determined constructing a rigid-plastic spectrum. This procedure is applied for the design of Three-story RC frame and good comparison is observed with respected to refined time-history analysis.

3. CONCLUSION

A new procedure for seismic design, the RPSD method is reviewed. This method is based on the Theory of Plasticity and follows the principles of Performance-Based-Design. The basic idea that is used to neglect the contribution from elastic displacements when determining the dynamic response of a structural system. The procedure is applied for design of framed structures where plastic deformations are expected to be much larger than the elastic ones. The procedure is quite simple and the designer has full control over the final design of the structure, since suitable collapse mechanism is selected during the analysis. The use of general rigid-plastic spectrum and of the extreme loading scenarios allows the procedure to effectively separate the properties of the ground motion with those of the structure to be designed. The design examples available in the literature highlighted the simplicity of the method. The dynamical performance of the structure designed by RPSD method was compared with refined NLTHA. Results presented showed that the structure performed as expected by the formation of the chosen collapse mechanism and by satisfying maximum displacement and strength demand. Hence, the RPSD method may be quite useful for structural design against string ground motion.

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Evaluation of Drinking Water Quality in Colleges of Karvir Taluka

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ABSTRACT

This paper presents the analysis of physico-chemical and biological parameters for drinking water quality status of engineering colleges in Karvir Taluka. The sampling sites were selected based on their importance. The parameters such as temperature, pH, D.O., turbidity, alkalinity, TDS, chlorides, hardness, nitrate and MPN were determined as per standard methods. Due to several reasons, the water is deteriorating. In this paper, the water quality indicators were analyzed for four selected study regions. It was observed that in a few study regions, the quality of water is not good and the main cause of deterioration is due to the lack of proper sanitation, an untreated inflow of water with Kolhapur municipal sewage and uncontrolled anthropogenic activities. This study has been found useful in evaluating a particular drinking water quality and deriving some conclusions about quality of drinking water.

KEYWORDS

Physico-chemical and biological, pH, D.O., Turbidity, Alkalinity, TDS, Chlorides, Hardness, Nitrate, MPN.

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1. INTRODUCTION

The quality of water should be assessed based on physio-chemical parameters in order to provide information for water management [1]. Pollution of surface and groundwater is a major problem due to the rapid growth of urbanization and industrialization [2]. A clean and adequate water supply is necessary for the health of all living organisms and ecosystems, including people and their activities [3]. According to the scientists of the NEERI, Nagpur, India, about 70% of the available water in India is polluted [4].

Karvir is a taluka in Maharashtra situated at 16.6976° North 74.2266° East. It is situated on the banks of the sacred river Panchgangaa flowing in the South-West part of Maharashtra, India. The population of Karvir in Maharashtra State was 13,28,273 as per 2022 the census and is expected to grow further on account of rapid

urbanization., There are main four engineering colleges in In Karvir taluka where approximately six thousand students are taking education.

In Karvir taluka, inapt waste management, not following scientific sewage disposal and incaution of the industries deteriorate groundwater quality in and around [5]. It is essential to monitor the drinking water quality which is supplied to the colleges around Karvir taluka. Hence, the present study was undertaken to evaluate the parameters of drinking water quality of colleges in Karvir taluka.

2. EXPERIMENTAL SECTION

2.1 Study Area

Karvir is a taluka of Kolhapur district situated at 16.6976°N 74.2266°E, Maharashtra, India (see **Figure-1**).

Figure-1. Map of Karvir Taluka.

2.2 Sampling Sites

Drinking water samples were collected from following sites:

i. DYPCE, Kasba Bavda.
ii. BVCET, Morewadi.
iii. KIT, Kandalgaon and
iv. DOT, Shivaji University, Kolhapur.

2.2.1 Water Sampling

The drinking water samples were collected from the sampling points and analyzed in the laboratory. The parameters for examination of water were temperature, pH, D.O., Turbidity, Alkalinity, TDS, Chlorides, Hardness, Nitrate and, MPN and were determined as per standard methods prescribed by American Public Health Association [6, 7]. pH meter and standard centigrade thermometer were used to measure pH and temperature. D.O. was checked in the laboratory.

2.2.2 Sample Collection and Analysis

In the research work, the drinking water sample is collected from the sampling site in polythene bottles of 1.0-litre capacity with a stopper. The bottles were rinsed 3 times with sampling water. The sampling used for MPN was separately collected in sterilized bottles and all cares were taken for transportation to the laboratory in one hour [8]. Each bottle was clearly marked with the name and date of sampling. The engineering colleges samples taken into the study are numbered as I, II, III and IV. The samples are collected in clean polythene bottles at the interval of each week from Feb 2011 to Jan 2012. **Table-1** shows the parameters and methods for water examination.

Table-1. Parameters and methods for water examination.

Sr. No.	Parameters of water analysis	Methods
1	pH in Standard Units	Electrometric method
2	Dissolved Oxygen (D.O.) in mg/L	Modified wrinkle's method
3	Turbidity in NTU	Nephelometric method
4	Chloride in mg/L	Mohr's method
5	Total Alkalinity in mg/L as $CaCO_3$	Titration method
6	Total Hardness in mg/L	EDTA titrimetric method
7	Total Dissolved Solids in mg/L	Gravimetric method
8	Nitrates in mg/L	Spectrophotometric method
9	MPN/100 ml	Multiply tube fermentation method

3. RESULTS AND DISCUSSION

3.1 Temperature

The water temperature recorded at collection time ranged from 25°C to 30°C. Conformed values of temperature are not recommended in any standards.

3.2 pH

The pH values of sampling sites I, II, III and IV varied from 6.88 to 7.69, 6.83 to 8.09, 7.24 to 8.00, and 7.59 to 8.21 respectively. However, as per the ISI standard and WHO (1998) [9], the observed pH values of sampling sites were within permissible limits of (6.5 to 8.5) (see **Figure-2**).

3.3 Dissolved Oxygen (D.O.)

The D.O. is one of the important parameters in water quality assessment. The D.O. values change according to the rate of respiration and decomposition of organic materials in the water. The pollution process tends to deplete dissolved oxygen in the water. The D.O. values of sampling sites I, II, III, and IV ranged between 4.75 - 7.70, 4.93 to 6.41, 5.00 to 7.56 and 5.26 to 8.81 mg/L respectively. A dissolved oxygen range of 5 mg/L is normally acceptable as per guidelines suggested by WHO standards (see **Figure-3**).

3.4 Turbidity

If a significant amount of particular matter is present in the suspended water, then it is considered as turbid water. The water was found to be more turbid during the rainy season at various sampling sites. The turbidity values of sampling site I varied from 0.9 NTU to 9.3 NTU. The turbidity values of sampling site II varied from 1.0 NTU to 5.1 NTU. The turbidity values of sampling site III varied from 0.8 NTU to 4.6 NTU. The turbidity values of sampling site IV varied from 0.3 NTU to 2.8 NTU. As per guidelines suggested by WHO, a turbidity range of 5 NTU is normally acceptable (see **Figure-4**).

3.5 Alkalinity

Alkalinity alone is not harmful to human beings [8]. Excess alkalinity gives a bitter taste to water. The alkalinity values of sampling sites I, II, III and IV ranged between 74 to 154, 78 to 310, 77 to 272, and 66 to 184mg/L respectively. As per guidelines suggested by WHO, the alkalinity ranges of 200 mg/L are normally acceptable (see **Figure-5**).

3.6 Total Dissolved Solids (TDS)

This is a measure of the solid materials dissolved in river water. This includes salts, some organic materials, and a wide range of other things from nutrients to toxic materials. The presence of high levels of TDS in water produces bad tastes and the public doesn't prefer to drink it. The TDS values of sampling sites I, II, III, and IV lie in 300 to 640, 425 to 676, 405 to 1060, and 270 to 600mg/L respectively. As per guidelines suggested by WHO standards the TDS values up to 500mg/L are normally acceptable (see **Figure-6**).

3.7 Chloride

The high level of chloride influences the physiology and reproductive biology of aquatic organisms. The Chloride values of sampling sites I, II, III, and IV ranged between 25.50 to 40.80, 36.82 to 75.42, 31.81 to 63.03, and 25.42 to 37.60 in mg/L respectively. As per guidelines suggested by WHO standards the Chloride range of 250 mg/L is normally acceptable (see **Figure-7**).

3.8 Total Hardness

The presents of salts of Mg and Ca increases the concentration of total hardness. The total hardness of water is the sum of the concentration of alkaline earth metal cations present in it. The total hardness values of sampling sites I, II, III, and IV varied in from 94 to 219, 104 to 298, 120 to 266 and 91 to 173mg/L respectively. As per guidelines suggested by WHO standards, the total hardness range of 200mg/L is normally acceptable (see **Figure-8**).

3.9 Nitrates

The nitrate concentration is very important in public water supplies because the higher concentration of Nitrates causes an illness known as infant methemoglobinemia in children, which hampers the transport of oxygen in the blood. The Nitrates values of sampling sites I, II, III, and IV were ranged between 2.20 to 5.70, 18.20 to 33.65, 11.08 to 26.60 and 0.28 to 3.2mg/L respectively. As per guidelines suggested by WHO standards the Nitrates range up to 50mg/L is normally acceptable (see **Figure-9**).

3.10 Most Probable Number (MPN)

Biological parameters are a very important human point of view. All natural water contains a variety of organisms, both plants and animals as the natural flora. In the water receiving sewage waste and industrial waste, a plethora of pathogenic organisms may present. The safety of the water is generally judged from the knowledge of sanitary conditions and mentioned by the number of samples yielding positive or negative results. If more than 95% should yield negative results, safety is usually assured. When the faecal coliforms value is high, the dissolved oxygen (D.O.) value will be naturally low, because these pathogens will absorb D.O. for oxidizing the organic matter present in these water samples. The presence of coliform bacteria causes gastroenteritis and urinary tract infections. An MPN of a coliform range of 10/100ml is normally acceptable as per guidelines suggested by WHO standards (see **Figure-10**).

The MPN values of sampling site I range between <1.1/100mL to 23/100mL. The MPN values of sampling site II ranges from 5.1/100mL to >23/100mL. The MPN values of sampling site III range between <1.1/100mL to 7.2/100mL. The MPN values of sampling site IV range from 1.1/100mL to >23/100mL.

Based on the present investigation, it can be concluded that the sampling site I shown pH, D.O., alkalinity, chlorides, total hardness, and nitrates within the limits while turbidity, TDS, and MPN exceeded. Sampling site II shown pH, D.O., turbidity, chloride, total hardness, and nitrates within the limits while alkalinity, TDS, and MPN exceeded. The sampling site III showed pH, D.O., turbidity, Chloride, total hardness, nitrates and MPN within the limits while alkalinity and TDS

exceeded. The sampling site IV showed pH, D.O., turbidity, alkalinity, chloride, total hardness, and nitrates within the limits while TDS and MPN exceeded. **Table-2** shows the monthly variations of physio-chemical and bacteriological parametric data.

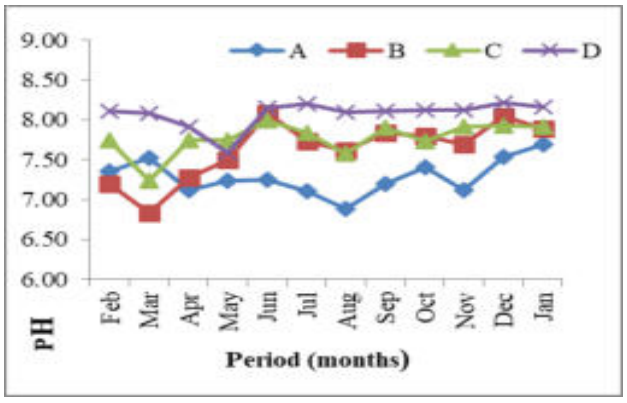

Figure-2. pH of the sampling sites.

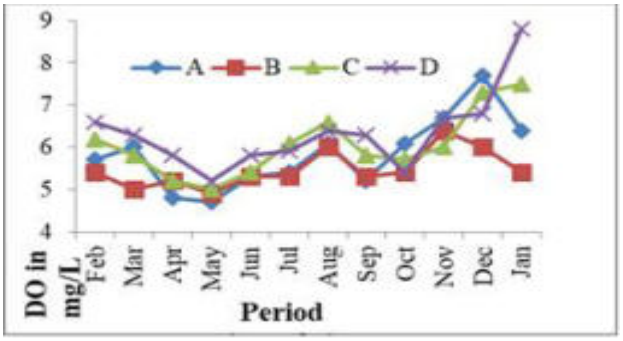

Figure-3. D.O. of the sampling sites.

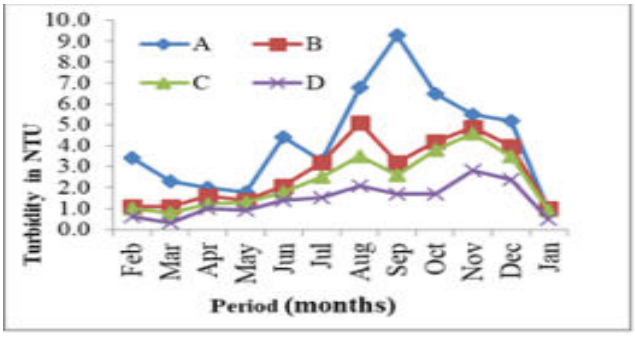

Figure-4. Turbidity of the sampling sites.

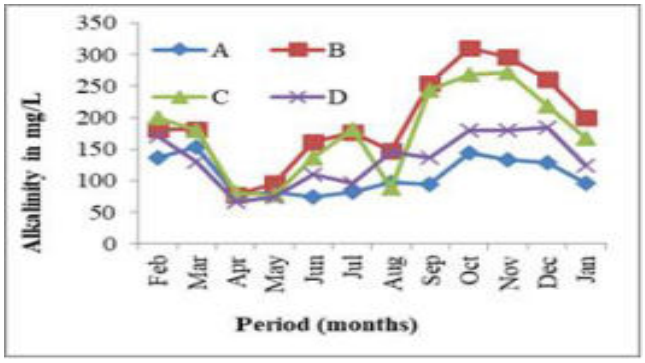

Figure-5. Alkalinity of the sampling sites.

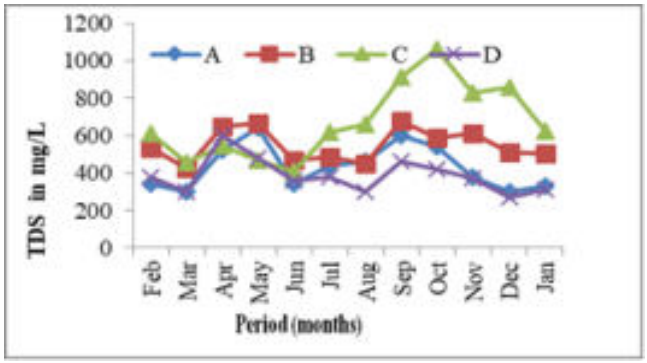

Figure-6. TDS of the sampling sites.

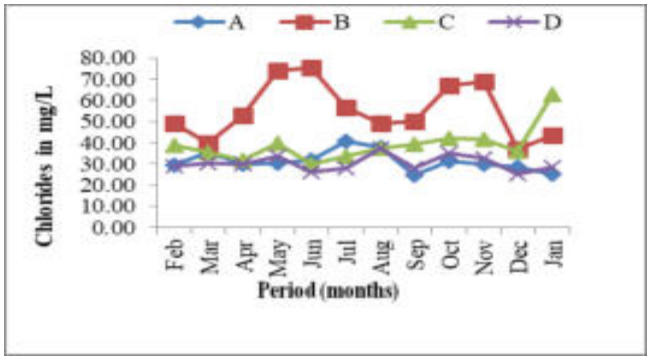

Figure-7. Chloride of the sampling sites.

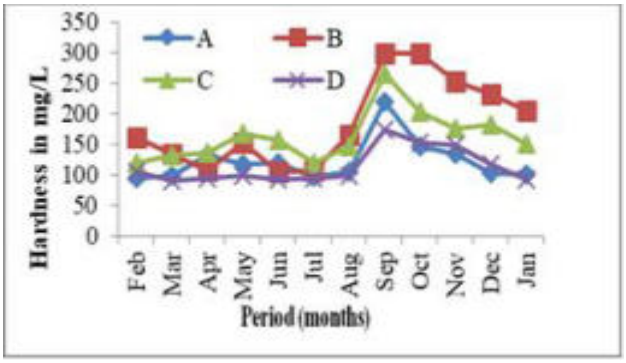

Figure-8. Total Hardness of the sampling sites.

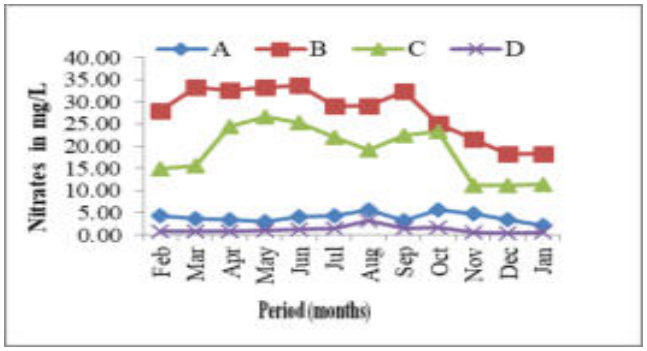

Figure-9. Nitrate of the sampling sites.

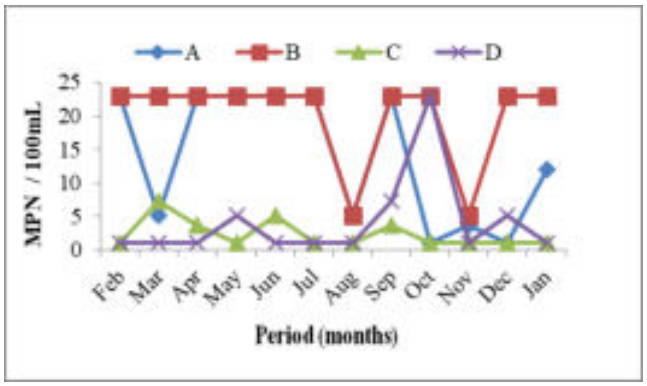

Figure-10. MPN of the sampling sites.

Table-2. Monthly variations of physio-chemical and bacteriological parametric data.

Month., sampling site		pH	D. O.	Turbidity	Alkalinity	TDS	Chlorides	Hardness	Nitrate	MPN
Feb 2011	I	7.36	5.7	3.4	136	340	29.30	94	4.35	>23
	II	7.20	5.4	1.1	182	535	49.28	162	28.10	>23
	III	7.75	6.2	1.0	200	615	39.10	120	14.90	<1.1
	IV	8.11	6.6	0.6	170	380	29.15	106	0.7	1.1
Mar 2011	I	7.53	6.0	2.3	154	300	35.60	98	3.75	5.1
	II	6.83	5.0	1.1	182	425	39.66	135	33.20	>23
	III	7.24	5.8	0.8	180	455	35.83	131	15.50	7.2
	IV	8.08	6.3	0.3	130	300	30.42	91	0.85	1.1
Apr 2011	I	7.12	4.8	2.0	78	520	30.00	132	3.40	>23
	II	7.27	5.2	1.6	78	648	53.00	108	32.64	>23
	III	7.75	5.2	1.2	80	548	31.81	136	24.40	3.6
	IV	7.92	5.8	1.0	66	600	30.07	95	0.80	1.1
May 2011	I	7.24	4.7	1.8	82	640	30.50	117	2.90	>23
	II	7.50	4.9	1.4	96	665	74.25	152	33.25	>23
	III	7.75	5.0	1.3	77	465	39.75	167	26.60	<1.1
	IV	7.59	5.2	0.9	74	480	33.80	99	1.00	5.1
Jun 2011	I	7.25	5.3	4.4	74	340	31.66	120	4.10	>23
	II	8.09	5.3	2.1	161	465	75.42	104	33.65	>23
	III	8.00	5.4	1.8	136	405	30.08	157	25.40	5.1
	IV	8.15	5.8	1.4	110	360	26.00	93	1.20	1.1
July 2011	I	7.11	5.4	3.3	82	440	40.80	96	4.40	>23
	II	7.73	5.3	3.2	177	485	56.66	108	29.15	>23
	III	7.84	6.1	2.5	182	618	33.75	120	22.05	1.1
	IV	8.20	5.9	1.5	96	380	28.08	95	1.35	1.1
Aug 2011	I	6.88	6.1	6.8	98	460	38.00	104	5.60	5.1
	II	7.61	6.0	5.1	148	450	49.41	166	29.00	5.1
	III	7.58	6.6	3.5	88	660	37.28	146	19.15	<1.1

	IV	8.10	6.4	2.1	146	300	37.60	99	3.2	1.1
Sep 2011	I	7.20	5.2	9.3	94	600	25.00	219	3.15	>23
	II	7.84	5.3	3.2	254	676	50.32	298	32.40	>23
	III	7.90	5.8	2.6	244	912	39.30	266	22.40	3.6
	IV	8.11	6.3	1.7	136	460	28.10	173	1.52	7.2
Oct 2011	I	7.41	6.1	6.5	144	540	31.20	146	5.70	<1.1
	II	7.80	5.4	4.2	310	590	67.10	298	25.20	>23
	III	7.73	5.7	3.8	268	1060	42.06	203	23.34	<1.1
	IV	8.12	5.4	1.7	180	420	35.00	152	1.67	>23
Nov 2011	I	7.12	6.7	5.5	134	380	30.00	135	4.70	3.6
	II	7.70	6.4	4.9	297	610	68.96	253	21.60	5.1
	III	7.91	6.0	4.6	272	830	41.76	176	11.25	1.1
	IV	8.12	6.7	2.8	180	370	32.65	149	0.65	1.1
Dec 2011	I	7.54	7.7	5.2	128	300	28.40	103	3.45	<1.1
	II	8.04	6.0	4.0	261	512	36.82	232	18.32	>23
	III	7.93	7.3	3.5	218	856	36.23	181	11.08	<1.1
	IV	8.21	6.8	2.4	184	270	25.42	118	0.28	5.1
Jan 2012	I	7.69	6.4	0.9	96	330	25.50	100	2.20	12
	II	7.89	5.4	1.0	200	505	43.80	205	18.20	>23
	III	7.91	7.5	0.9	168	625	63.03	151	11.45	<1.1
	IV	8.16	8.8	0.5	124	310	28.78	92	0.55	1.1

4. CONCLUSION

The quality of drinking water in study region IV was the clean, study region III was slightly polluted, study regions I and II were shown moderate pollution range. The drinking water quality of sampling sites changed from clean to moderate pollution condition.

ACKNOWLEDGMENT

I would like to express my special thanks to the Director and Principals of the Engineering Colleges who gave me the golden opportunity to do this wonderful research work on the present topic. Secondly, I would also like to thank my parents

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Smart Attendance System using Face Recognition

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ABSTRACT

In today's technologically advanced era, many traditional problems are being tackled using new innovative technologies. Taking daily attendance at schools and colleges as well as offices is a must. As done manually, it is both exhausting and requires more time. A smart attendance system is proposed in this paper. Face detection and recognition methods are used in this system, to recognize the student and automatically detect him when he enters the classroom. This paper explains the system architecture and algorithms utilized at each level. Several real-time scenarios are investigated to test the efficiency of various facial recognition systems. This paper also suggests techniques for dealing with threats such as spoofing. This technique saves time and aids in student monitoring when compared to conventional attendance monitoring.

KEYWORDS

Face detection, Face recognition, Computer vision, Smart attendance, Student monitoring

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1. INTRODUCTION

Every organization requires a consistent and accurate method for keeping track of their student's attendance and each organization has its unique way of doing so; for example, some organizations take attendance physically on a piece of paper by addressing students by their first names during class. To record students' attendance, the majority of colleges around the world use an attendance system. However, there are several drawbacks to the current paper/manual attendance system. It takes time and is distracting to pass an attendance form from one student to the next to sign. As a result of this issue, some lecturers postpone taking attendance until the conclusion of class; however, some students may be in a rush to leave the class and thus fail to sign the attendance sheet. Furthermore, some students do not attend class but sign a proxy attendance sheet. Lecturers may call names one by one to mark attendance in some circumstances, although this procedure takes a long time. Another issue is that some students arrive late to class, particularly in the morning. Furthermore, both the lecturer and the students may be disturbed by the opening and closing of the door during the lecture. As a result, the manual attendance system is not secure or

trustworthy. The use of facial recognition for attendance marking is an efficient way to implement an attendance system. Along with other ways, face recognition is more accurate and faster and reduces the possibility of proxy attendance.

2. LITERATURE REVIEW

In numerous universities, maintaining student attendance is the most challenging duty. Every institution has its means of keeping track of attendance, such as utilizing attendance sheet or biometrics. However, these methods take a long time. The majority of the time, students' attendance is taken using an attendance form provided to teaching members. This necessitates a significant amount of effort and time.

Several methods for maintaining attendance using face recognition have been reported. We constructed a model to improve accuracy using the references below as inferences.

A four-stage facial recognition system was designed by the author of [1]. Face identification using the Haar Cascade technique and skin color detection using images converted from RGB to YCrCb format, alignment using face structures regulation, feature mining, and classification using the LBPH algorithm were among the activities. Face recognition accuracy was 98.2 percent at a distance of 40 cm from the camera in lighting conditions (24 lux), and 94.7 percent in lighting conditions (24 lux) (7 lux). Face recognition precision declined as the distance among the camera and the subject increased from 40 cm to 90 cm.

In [2], Using CNN, the authors created a face recognition-based automatic attendance system. The system created in Python which is created in Python can detect and recognize with a 92 percent accuracy rate.

The authors in [3] offer a face recognition system for people with visual impairments that includes three main modules: dataset building, dataset training, and facial detection. Faces in a live video are detected using the Haar Cascade Classifier, and then a face recognizer is created using the OpenCV-Python package utilizing the Local Binary Pattern Histogram (LBPH) approach. This scheme is capable of detecting and recognizing several people and recognizing from both the front and side faces. The overall accuracy of face recognition is around 93%.

The topic of facial expression was tackled in two steps by the author of the paper [4] face detection and emotion recognition. The Multi-Task Convolution Neural Network (MTCNN) accurately detected the borders of the face with minimal remaining margins when used for face detection. The Shuffle Net V2 architecture was used for sentiment recognition, which trades off the model's accuracy and efficiency.

Implemented an attendance monitoring system using [5] smartphones available to class teachers. "You Only Live Once" is the acronym for "You Only

Live Once." A real-time object approach was used for face detection, and a Siamese network was used for face recognition. The proposed system was efficient and reliable, as the Siamese network demonstrated. Face recognition accuracy has improved.

A facial recognition and machine learning algorithm-based attendance system was suggested by the author [6]. Face detection was done using Single Shot Multi-Box Detect (SSD), which consisted of 128 embeddings of a pre-trained Face Net model that were enhanced based on triplet loss. The proposed system's accuracy was 97 percent, according to the trial's findings. Face recognition problems were solved, but the approach was unable to identify every student in the class. The Faster Region-based Convolutional Network is presented in [7].

In [8] LBP, a 3x3 window is used to take a piece of a grayscale image, compare the pixel value of the neighborhood to the principal pixel value, and then assign a binary value, which is then transformed to a decimal value. An LBPH algorithm is created by combining LBP with histograms. GPU (Graphics Processing Unit) is a more powerful electronic circuit than a CPU (Central Processing Unit). The LBPH technique is used to implement forward and lateral profile face recognition on GPU in this paper. After that, the CPU and GPU results are compared.

Because of their resilience, the authors in [9] chose the Haar cascade for face detection and the LBPH process for face recognition. It withstands monotonic grayscale modifications with ease. This system is evaluated utilizing circumstances such as facial recognition speed, false-positive degree for that, and false-positive degree by means of and deprived of a threshold in detecting unfamiliar individuals. The author discovered that pupils' facial recognition frequency is 77%, with a false-positive rate of 28%. Students are recognized by this technique even if they are wearing spectacles or have developed a beard. Face recognition of unfamiliar people is about 60% with and without the use of a threshold value. Containing and excluding a threshold, its false-positive speed is 14% and 30%, respectively. The authors implemented smart attendance system using Face Recognition in [10]. Pawaskar et al. [11] presented automated attendance system with the help of face recognition.

3. PROPOSED SYSTEM

Figure-1 shows the working of the system. There are two parts to this system. Face detection and recognition are two different things. Face detection captures the image first, then extracts face features using a cascade classifier and stores them in a database. Face recognition recognizes faces and compares them to previously stored data in the database, displaying the results of the recognized person.

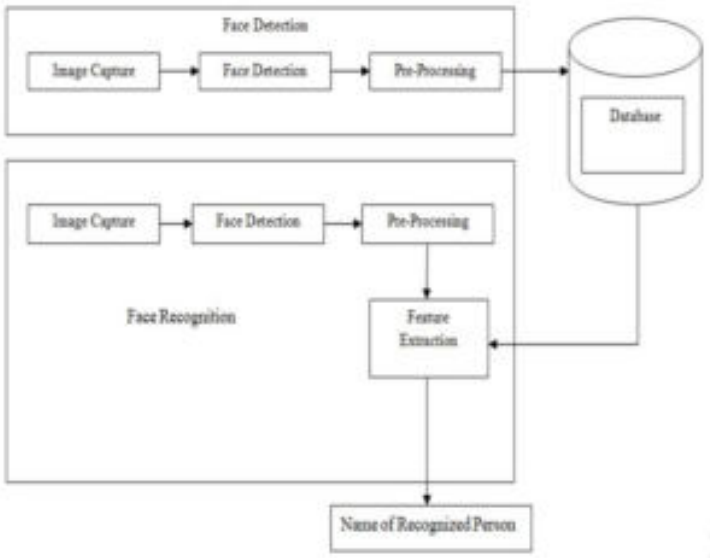

Figure-1. System architecture

3.1 Architecture

The design of the automated attendance management system is relatively simple and easy to install. Two databases, a student database but also an attendance database, make up the system. The student database contains information about students in a specific course. The attendance database is used to track and retain the attendance figures of students who attend a specific lesson.

3.2 Methodology

Some measures must be taken in order to construct an intelligent attendance management system. The steps can be broken down into the following categories:

- Enrollment
- Face Detection
- Face Recognition

3.2.1 Enrollment

The student is now registered in the student database. The database stores general information such as Identity, PRN, Division, and Branch. In the student database, photos of the student's face stand alongside all of this information. Facial recognition can be conducted for all students who are attending a lecture with all of the photographs recorded in the student database.

3.2.2 Face Detection

The above-mentioned markers located on a person's face can be used to detect faces. The Haar Cascade technique is used for face detection.

3.3.3 Face Recognition

The Local Binary Patterns Histogram will be used to execute facial recognition in this model (LBPH). The proposed approach can take an image of the person from a recording device. Using the Haar Cascade classifier, the approach can then detect people's faces from the video camera. After that, the discovered faces are matched to the previous classification results. A histogram is constructed for each picture in the training sample to characterize the picture. The same methods are followed to build a histogram summarizing input data.

The student is granted access to the classroom if the student's face is matched in the appropriate database. If a student is not granted permission to the classroom, then the system will prompt the student to register in the database.

4. RESULTS AND DISCUSSION

Maintaining the attendance record is a difficult job. For the face recognition part, we have used the Haar Cascade classifier with the help of this we detect faces and store them in the database. For face recognition, we have used the LBPH algorithm.

Admin module

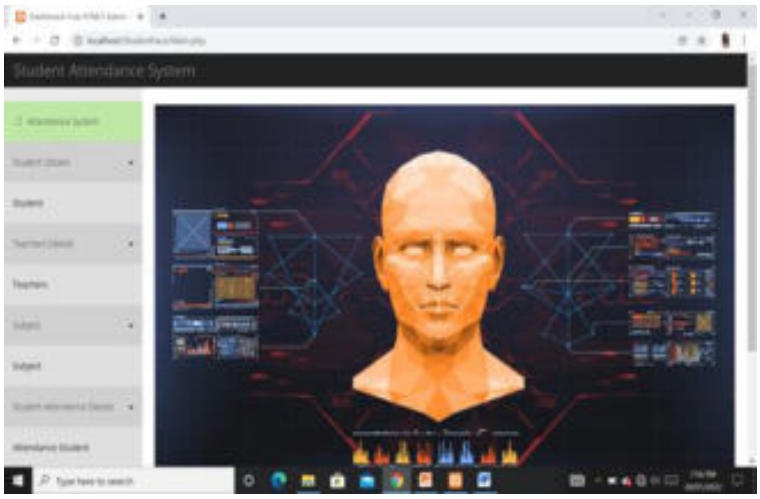

Figure-2. Admin Module

The admin module as shown in **Figure-2** has two pages, the first of which is an index, and the second of which is admin details. Once logged in, the administrator sees all the student information and controls all of the records in the system. Admin acts as a delegated authority.

Teacher module

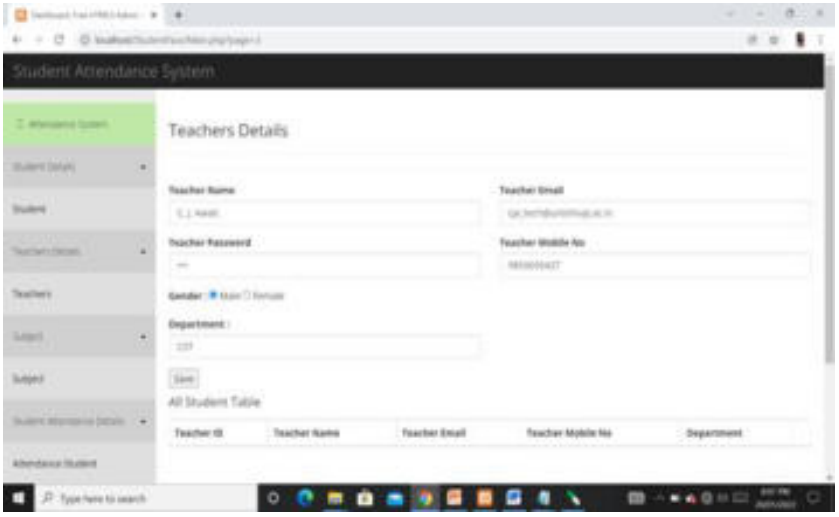

Figure-3. Teacher Module

Admins can add new teachers and update their information in the teacher module as shown in **Figure-3**. Here all rights are given to the admin.

New student registration module

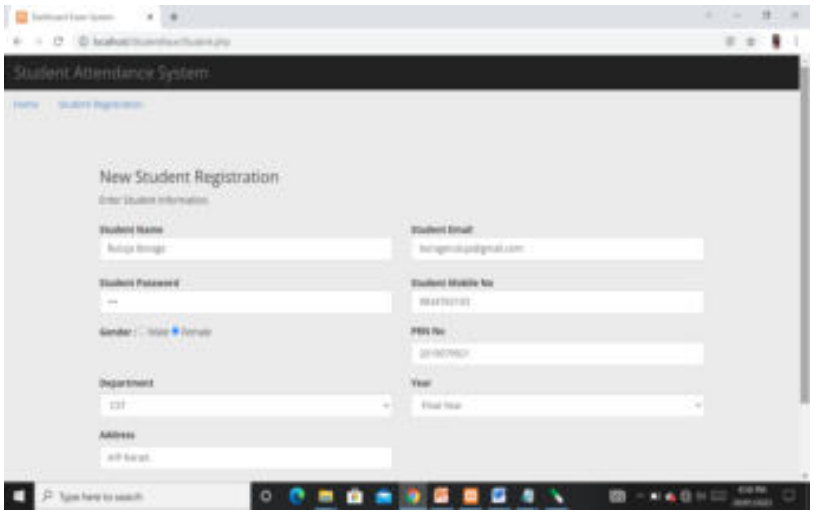

Figure-4. Registration Module

In this registration module, a new student adds their information as well as register in that system as shown in **Figure-4**.

Attendance report

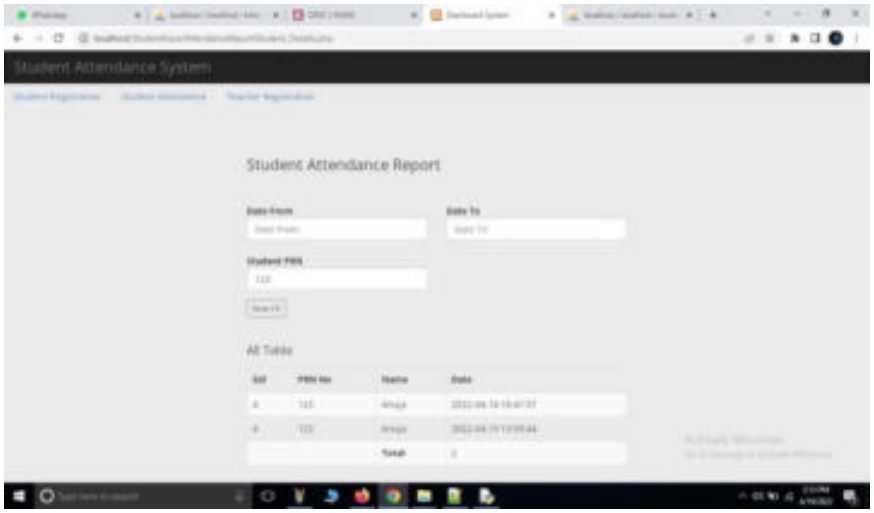

Figure-5. Attendance Report

In this module, student attendance reports are shown in above **Figure-5**.
Face Detection:

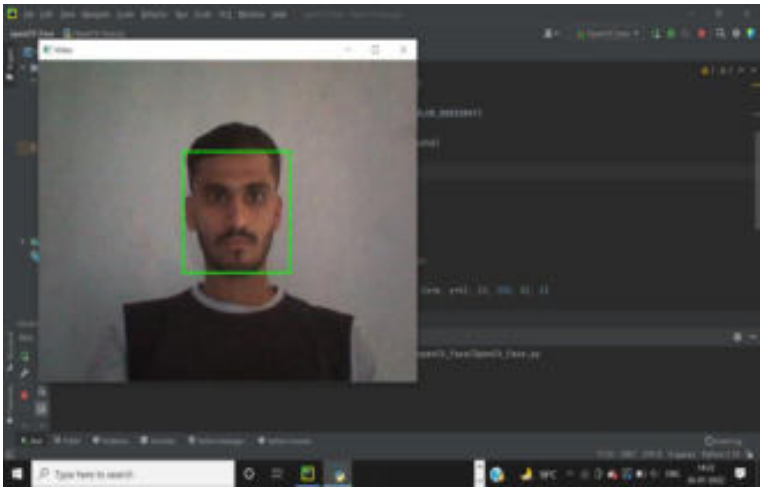

Figure-6. Detection Module

The detection part is displayed in **Figure-6**.

Face recognition

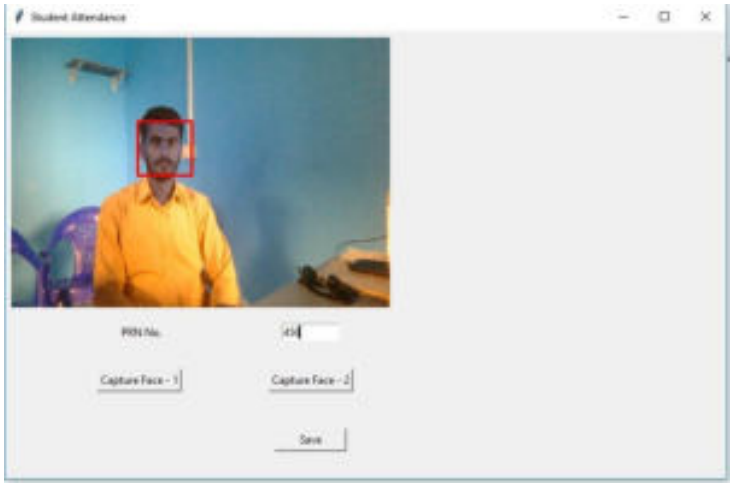

Figure-7. Face Recognition

The recognition part is shown in **Figure-7**.

Performance measures

In this paper, we have created one dataset called FaceDataset. Which is consist of 100 images. All of the images were taken under various lighting and occlusion circumstances. Many recent studies have shown that machine learning and deep learning methodologies may be applied with a minimal dataset. For example, for the chest radiograph's binary classification, the authors in [12] used 100 pictures. The proposed system is analyzed using performance measures like accuracy, precision, recall, and F1 score.

Table-1. Performance Measures

Parameter	Proposed system
Accuracy	97%
Precision	96%
Recall	50%
F1 Score	6.5%

Table-1 summarizes the accuracy, precision, recall, and F1 score with the data set for the LBPH algorithm. The accuracy of the purposed system is calculated as 97%, and precision and recall are calculated as 96% and 50% respectively. Additionally, the F1 score achieved for LBHP is 6.5%.

5. CONCLUSIONS

A system that detects and recognizes the presence of a person is developed using face recognition. These techniques are effective with a wide range of facial expressions and body positions. Facial recognition is a workable solution due to its high precision and limited human involvement. This system's aim is to promote a secure system. Hence, a highly efficient classroom attendance system that can recognize multiple faces at once is constructed. Furthermore, no distinct hardware is required. A camera, a computer, and database servers are all that is needed for the smart attendance system. In various stances and variations, the system operates well. This system needs further improvement because it sometimes fails to recognize students from a distance, and we have certain processing limitations. Working with a high-processing system may result in an even better performance of this system.

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Study and Analysis of Campus Placement System using Cloud Computing

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ABSTRACT

Cloud computing is gaining importance in day-to-day business scenarios because of its scalability, robustness, and cost-saving capabilities. A management information system is one of the major components of any business organization. It helps to adopt a future operating strategy, determine day-to-day operating procedures, and analyze various financial and operational data. It requires a huge investment and complex management of the whole system. Computers are touching our lives in more dimensions than we realize in today's technological world like computerized management, electronic information storage, actual record changes, and computerized report generation. The proposed approach provides a public cloud service configuration that will offer a plethora of facilities to academic and non-academic organizations. All participating organizations will have a profile on a common framework that will be utilized for public affairs and customer interaction, allowing them to promote themselves and be found by clients who are looking for innovative benefits. All collaborating organizations will receive a cloud-based organizational management system that can be managed from everywhere by everyone with the necessary access privileges.

KEYWORDS

Cloud computing, Data recovery, Smart campus, Backup repository, Information system

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1. INTRODUCTION

Smart Campus using Cloud Computing is software that helps both the students and the management authorities of the college. Our Smart Campus can store the data for the students and teachers and maintain their details in a dynamic order. This software can help us explore all the activities happening inside the college that we, as students, do not have any knowledge about. It can handle the details of students' and teachers' departments year-round. In this system, the teacher can maintain every detail of subjects, placement, examinations, and syllabus for students in his department. He can also post any notice corresponding to his department. This

system provides a detailed structure of the departments of the college and the facilities of the college. The proposed system synchronizes the workings of all departments. Smart Campus Cloud seeks to create a public cloud platform that will operate as a major hub for academic and non-academic organizations for promotion and administration reasons, drastically reducing workload and optimizing performance. The organizations would be granted a digital presence and a management platform that would be totally handled by Campus Cloud's engineers, as well as a customized website after they joined Campus Cloud. The organizations on board will acquire all the structures that are essential to run an organization, such as maintaining student data like assignments, projects, synopsis, placement, notes, unit test details, tutorials, seminar details, internship details, etc. Faculty can view this data. All of the organization's data will be kept in the cloud and made available on request.

2. LITERATURE REVIEW

A Literature review is carried out to study different issues related to the smart campus system of the institute the literature review is as follows:

The analysis and study show that the new information technologies are playing more and more important roles in improving education innovation using the smart campus. It is also a kind of creativity of developing talent, improving management, and optimizing services.

In this paper Cloud computing's convenience has enticed smart campuses to outsource their massive amounts of data to cloud servers. Although data outsourcing might help smart campuses lower their computing and storage costs, privacy protection becomes the most important consideration. Many researchers have been drawn to this topic to investigate the security of outsourced multimedia data. This paper investigated and assessed the suggested scheme's safety. This paper also carried out a huge number of tests on the suggested scheme [1].

Here author discussed, that social networks have grown fast in tandem with the growth of smart campuses, necessitating high accuracy in man-machine and man-machine interaction technologies. As a result, physiological information has become a significant addition to, if not a replacement for, acoustic-based features in speech interaction processing [2].

Here author proposed the protocol has been explicitly proven to have strong reliability and solid security due to the vast data operations and storage that has been transferred to readers and back-end data. Furthermore, the authentication protocol proposed in this paper has better storage and calculation performance, and it can better satisfy the security requirements, when compared to other existing authentication protocols on resident variable storage overhead, cost of computing complexity, and security performance [3].

In this paper, in the age of information, understanding the sensations of professors and students in real-time has become a pressing issue for all colleges and institutions. The public opinion monitoring platform of the smart campus was evaluated using UML modeling, and the campus public opinion of numerous key events was watched and analyzed. This served as a model for detecting public opinion at colleges and institutions in an effective, intelligent, and real-time manner. In platform design, this study examined the creativity, openness, and security of campus public opinion monitoring. The development of this platform was crucial to a thorough understanding of all elements of students in colleges and institutions [4].

This study examines smart campus characteristics from many perspectives and develops a smart campus architectural model. This study establishes a framework model of educational data collection and storage platform for the smart campus, which provides a reference model for the building of smart campuses in universities, with a focus on the research content of teaching performance evaluation [5].

This study proposes a community cloud service setup that will offer a variety of services to academic and non-academic institutions. All of the institutions engaged will have a presence on a single platform that will be utilized for public relations and consumer contact, allowing them to promote and get discovered by customers searching for different services. They will also acquire a customized website and an Android application. Finally, each of the participating institutions will be given access to a cloud-based institute management system that can be accessed from anywhere and by anyone with the appropriate access permissions. Because Campus Cloud primarily serves educational institutions, because the institution's structure or manner of operation would not need to be considerably changed, the threat would be minimal. The perfect level of integration would be determined by the needs of a specific business, with the Campus Cloud service's modular and on-demand structure giving the best possible benefits to end-users [6].

In this paper due to service cloud resource management based on vertical and horizontal climbed systems, most cloud service consumers experience service delays and disruptions. Vertical scaling refers to adding more resources to a single cloud server, while horizontal scaling refers to increasing the number of servers. The proposed architecture effectively managed service bursts by addressing load balancing issues via horizontal auto-scaling to assure application consistency and service availability. The study used a smart campus environment model to mimic the monitoring of time-stamped heterogeneous service requests that appeared with varying workloads [7].

In that paper advantage of the benefits of centralized processing via cloud computing and develop the notion of data forwarding priority to assure data

distribution continuity. By upgrading existing multicast technology, we propose a multicast infrastructure based on cloud computing that can effectively employ the bandwidth of the cloud center. Because of the cloud's characteristics, data distributions can be more dependable [8].

This paper method is nearly as efficient as existing high-performing private auditing schemes, and it is more effective than existing high-performing public auditing schemes. We propose a public/private auditing paradigm and a public/private auditing security model [9].

Compares standard quantitative characteristics of on-campus and off-campus engineering graduate students. These factors include chronological age, undergraduate degree age, GRE Verbal, Quantitative, and Analytic exam scores, and undergraduate quality point average [10].

In this paper is an enormous amount of data available in today's big data era. This proposes a system that creates recommended workflows for classification tasks automatically and efficiently executes the workflows remotely and in parallel in a cloud computing environment. The system demonstrate has an intuitive Web-based interface, and its scalability was shown by scheduling concurrent workflow execution on a cloud infrastructure. When high-quality stock workflows are contributed to the repository, the system's speed can be improved over time [11].

Large amounts of data can be stored in a cloud environment. Recovery services are required to ensure the efficiency of those data. A huge amount of private data is saved on the main cloud in cloud computing. As a result, the need for recovery services is increasing every day, necessitating the creation of an efficient and effective data recovery service technique. We're putting in place a cloud computing infrastructure with data backup and recovery via indexing. Because we simply store MFT (Master File Table) records in our system, we allocate the smallest amount of memory to the backup system [12].

The author introduced that Government and industry are concerned about the susceptibility of cloud computing systems (CCSs) to advanced persistent threats (APTs). The results demonstrate that implementing a limited set of security controls increases the risk of CCS penetration (high-value data breach) [13].

Here author presented the campus network is a basic service, smart campuses have recently become a popular research area. Fast, powerful, and safe campus networks are required to support smart campuses. Viruses of many forms may, however, endanger school networks, posing a security risk to smart campuses. It's critical to understand how a virus could spread via a smart campus network in order to improve the network's security and reliability. The security and robustness of smart campuses can be enhanced by understanding how such transmission occurs [14].

This study demonstrates and examines the present state of smart campus research, as well as the challenges of integrating various types of service data. Based on previous studies on the architecture for a situational awareness system for smart campuses, this study examines and builds a smart campus service discovery algorithm and a perceptual data fusion algorithm. The smart campus can manage perceptual data more efficiently than traditional campus platforms, which makes campus service and management more convenient [15].

In this Literature, review data is stored in computer files or on paper under the current system, which leads to data loss. As a result, work performance suffers. There are numerous flaws in the current system. It's simple to keep track of a large amount of data in order to solve a system problem.

3. PROPOSED SYSTEM

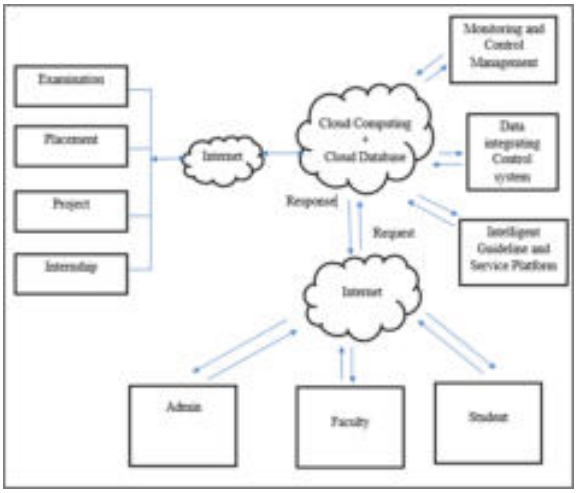

Figure-1. Architecture of smart campus

In the existing system work of the college is stored in local computer memory. So, there was required lots of memory storage because a huge amount of data is generated day today. Solve this problem by using cloud computing technology. In the existing system maintaining records of all student, faculty, or college-related data is difficult.

In this proposed system (**Figure-1**) there are different modules implemented, and each module provides a unique feature for the college education system first module is the training and placement module, in that module data of the student is gathered, and by using this data, various type of report generates depend on different criteria like percentage include above 75%, above 65%, and female and male criteria, backlogs, likewise.

The second module is an internship module in this module dates related to an internship like internship report, PPT, synopsis, etc. are collected from students. This helps the third-year student with internship training.

The third module is the project module, in that module students can submit their project work. In project work includes student can upload their project report, synopsis, and PPT presentation. And other different module exam modules, assignments, tutorials, etc. are other modules, here student can upload their assignment, and tutorial and also give their assignment, tutorial, and also give their exam in the exam module.

Admin phase has all authority of web application to activate the registered users, as well as faculty and student's faculty module, can access the all the details of students in the form table and download in pdf as it required form or structure. Faculty can view the data of students can be uploaded and faculty can upload study material as per their subject-wise. Also, Examination, Placement, Syllabus, Projects, and Internship details are available on the web application.

Student module can first register and then login into the system they upload the completed projects, internship reports, synopsis, and certificates. The student module has a notification module, in this module students see the notification of notices faculty can upload.

All data of the system is stored in the cloud database through the internet and all modules are requested to the cloud computing + cloud database and the cloud database sends the response of request through the internet. Cloud systems can monitor and control, data integrity can control and intelligent guidelines and service platforms are provided to the application.

4. METHODOLOGY

Cloud computing is a type of computing that stores data and distributes resources in open environments. Even though cloud computing is promising and efficient, there are numerous issues with data security because the data is not in the cloud user's immediate area. Cloud computing security has always been an important part of cloud service providers' quality of service. We presented a way of providing data storage and security in the cloud by utilizing a public key cryptosystem and the RSA algorithm to ensure data security. In a virtual environment, security services include key creation, encryption, and decryption.

5. RESULTS AND DISCUSSIONS

Smart Campus using a Cloud Computing project we develop a module like a student, faculty, admin, department, placement, project, internships, etc. we create a registration form for users. Admin can have all authority over this project. Admin can activate or deactivate the users. In the placement module, students can apply

company as per company eligibility criteria. Also, we can view the char analysis of our project as positive or negative. Notification module students can see the notification of notices uploaded by faculty for students.

The smart campus web application was developed and implemented and it is used as a cloud-based dynamic system for the deployment of information among staff or faculty, students and admin. The smart campus keeps track of both staff and students' information. The system has the capability of providing an online interface for students and faculty, increasing the efficiency of college record management.

All student data is registered in the smart campus cloud computing system and fetched in the cloud as a cloud database. In cloud computing and cloud database systems, the data fetching is performed in modules. In the placement module, all data is required from the faculty of students to send the company the required form on eligibility criteria. This output figure shows the placement module data fetching is done in multiple ways, as the given below puts the results of data fetching in the form of a table in pdf format. As follows as the 12th pass out of all students, only female students, and above 65% of final degree students, the data is fetched multiple ways.

Email Address	PRN	Year of Admissio	First Name	Middle Name
rutujachavan245	20180830362	2018	Rutuja	Dhanaji
prachimore@gm	20190799?3	2018	Prachi	Sanjay
patilvi0930@gmi	20180830450	208	Shreyash	Yallapa
atharva019@gm	20180856552	2018	Atharva	Hemant
neharkhot1999@	20190799?0	2019	Neha	Rajendra
riteshthakur246@	20180896?85	2018	Ritesh	Rajesh
agarribarea@gm	20190799?4	2019	Abhijit	Pandurang
sujaygaikwad007	20190799?9	2019	Sujay	Sardar
riteshthakur004@	20180896?85	2018	Ritesh	Rajesh
mahindrasaurabl	20180881?4	2018	Saurabh	Vijay
pranalliravan567(	20180860?5	2018	Pranali	Vijay
nehapakalez67@	20180831?0	2018	Neha	Shankarrao
indrajeetkandhar	20171101?8	2017	indrajeet	bhagwan
kishorikulkarni28	20180881?3	2018	Kishori	Kumar
shahistamujawar	20190866?3	2019	Shahista	Shaukat
rutvikkumbhar@t	20180842?6	2018	Rutvik	Ashok
vaibhavpujari9@	20161034?0	2016	Vaibhav	Nanasaheb

Figure-2. 12th Criteria

In the output **Figure-2**, pass-out students' criteria for 12th grade students with a degree are shown.

Patil	Female	Open	7/9/2001	patilvi0930@gmu	7030021052
Biradar	Female	Open	11/6/2000	shahubaibiradar(	9113657239
Chavan	Female	VJ-NT	10/17/2000	rutujachavan245	9130720662
Patil	Female	Open	4/22/2000	patilsayali831@g	7066240913
More	Female	Open	4/20/2000	prachimore@gm	7618936899
Khot	Female	Open	6/17/1999	neharkhot1999@	9730686789
Binjdar	Female	Hindu- Lingayat	3/25/2000	pratikshabinjdar	9420271542
Kamble	Female	SC	3/27/1998	kamblekomal280	7058723495
Jadhav	Female	Open	12/12/1999	41anuja.jadhav@	6180649492
Ravan	Female	Open	8/19/2000	pranalravan567(	9850604650
Pakale	Female	CST	6/21/1999	nehapakalez67@	+917420054934
Jadhav	Female	Open	6/2/2000	aankitajadhav2@	7498613008
Kulkarni	Female	General	7/29/2000	kishorikulkarni28	9359959522
Gawade	Female	NT-C	8/2/1999	archanagawade1	6080376976
Chavan	Female	sc	5/14/1999	yogita140351999(	7499210195
MUJAWAR	Female	Open	11/7/1995	Shahistamujawa	8766924317

Figure-3. Female Criteria

In the output **Figure-3**, the female gender criteria of students are shown.

Degree Aggr	Aggregate(Degre	No. of Live ATKT	No. of Dead ATK	Year of Passing I	Total Any Year G
74	76	0	0	2022	0
80	82	0	0	3022	0
68	0	No	0	2022	No
75	73	0	0	2022	0
0	0	0	0	2022	0
78	0	0	0	2022	0
70	0	0	0	2022	0
75	73	0	0	2022	0
72	70	0	0	2022	0
79	0	No	No	2022	0
78	79	0	0	2022	0
75	75	0	0	3	0
75.4	71.4	0	0	2022	0
76	72	0	0	2022	1 year

Figure-4. Above 65% Criteria

Above the 65% criteria in degree, final year students, as the percentage in the output **Figure-4** shows.

5.1 Performance Measure

In the performance measure table, both the existing and proposed systems outperform the existing system. For comparison, the first parameter is data accuracy. In the existing system, there was data duplication, so data accuracy is low as compared to the proposed system.

Table-1. Performance measures

Parameters	Existing System	Proposed System
Error Rate	2	4.5
Compatibility	2.5	3.5
Usability	2.5	4.5
Overall Quality	1.5	3.5

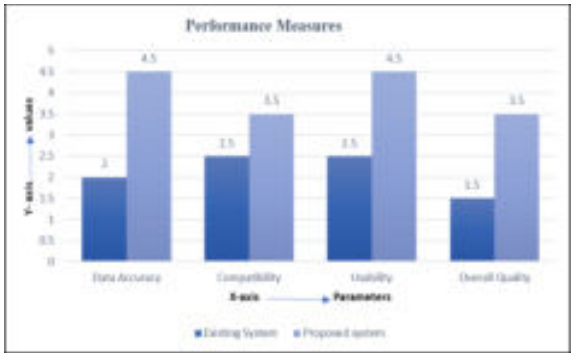

Figure-5. Performance measures

The second parameter is compatibility, which is compared between the existing system and the proposed system. The proposed system is more compatible than the existing system. The third parameter is usability. The proposed system is more user-friendly and easier to maintain in terms of huge amounts of data so the existing system is less useful in handling large amounts of data. The overall quality of the proposed system is higher than the existing system. Performance measure analysis is shown in **Table-1** and **Figure-5**.

5.2 System Comparison

Accessibility using the cloud, anywhere can access data through the internet without any interference. Speed, execution speed of the existing system is slow because the user can search data manually. The performance of the proposed system is increased. Due to the use of cloud computing technology, the existing system can be stored on a local computer or file so that the performance of the existing system is slow. The proposed system is more flexible to maintain consistency, integrity, and duplication of the data. The system comparison is shown in **Table-2** and **Figure-6**.

Table-2. System comparison

Parameter	Existing System	Proposed System
Data Accessibility	2.5	4.5
Speed of system	1.3	3.2
System Performance	3.5	4.5
Flexibility	1.6	2.8

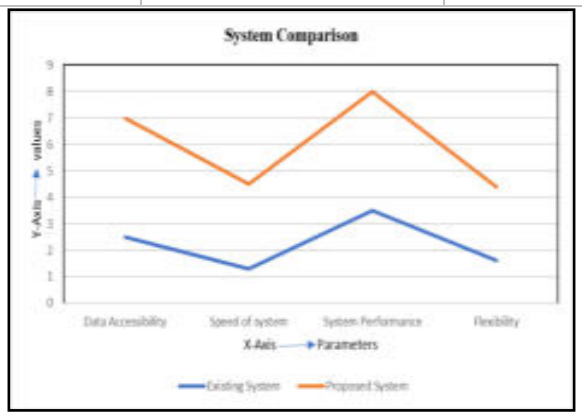

Figure-6. System comparison

6. CONCLUSION

This application is very useful for students as well as teachers. Students can learn more from this system. In the existing system, data is stored in computer files or paperwork, which leads to the loss of data. This leads to reduced performance of

work. There are lots of issues in the existing system. It is easy to maintain a huge amount of data for the solution of an existing system problem. It is also easily maintained by using cloud computing technology. In the proposed system, data can be stored in the cloud by using cloud technology. Students can access data at anytime, anywhere. Anyone can access data through the internet. It handles the details of students and teachers and maintains their details in a dynamic order. This software can help explore all activities happening inside the college. There are various modules: training and placement, project and internship modules, etc.

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