DESIGN AND DEVELOPMENT OF SMART WATER MONITERING SYSTEM AND PURIFICATION

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ABSTRACT:

The deteriorating water environment demands new approaches and technologies to achieve sustainable and smart management of urban water systems. Wireless sensor networks represent a promising technology for water quality monitoring and management. The use of wireless sensor networks facilitates the improvement of current centralized systems and traditional manual methods, leading to decentralized smart water quality monitoring systems adaptable to the dynamic and heterogeneous water distribution infrastructure of cities. However, there is a need for a low-cost wireless sensor node solution on the market that enables a cost-effective deployment of this new generation of systems. This paper presents the integration to a wireless sensor network and a preliminary validation in a wastewater treatment plant scenario of a low-cost water quality monitoring device in the close-to-market stage. This device consists of a nitrate and nitrite analyzer based on a novel ion chromatography detection method. The analytical device is integrated using an Internet of Things software platform and tested under real conditions. By doing so, a decentralized smart water quality monitoring system that is conceived and developed for water quality monitoring and management is accomplished. In the presented scenario, such a system allows online near-real-time communication with several devices deployed in multiple water treatment plants and provides preventive and data analytics mechanisms to support decision making. The results obtained comparing laboratory and device measured data demonstrate the reliability of the system and the analytical method implemented in the device.

Keywords:
smart city; water quality monitoring; Internet of Things; wireless sensor networks; water treatment plant; data analytics; nitrate; nitrite

I. INTRODUCTION:

Water is a scarce and precious resource that is being put under pressure due to the fast-growing population that is extracting too much water and polluting our rivers, lakes, and groundwater with municipal, agricultural, and industrial wastes. Climate change, loss of biodiversity, unsustainable use of natural resources, and environmental pressures have a negative impact on water quality and quantity which are inextricably linked, with over extraction causing low river flows, low ground water levels, and drying up of wetlands. The deteriorating water environment, accelerating the shortage of water and affecting human health, has become an important problem that restricts the development of cities.

One of the most important environmental problems today is, undoubtedly, the contamination of water by nitrates, especially in areas with significant agricultural activity, as occurs in the southeast of Spain [1,2]. The nitrates are natural components of soil and water, both surface and underground, which come, in part, from the decomposition of nitrogenous organic matter, although their presence in the soil and in aquifers increases with the use of

nitrogenous fertilizers and manure in areas with a high level of agricultural activity. Farmers invest large amounts of nitrogenous fertilizers in the fields to maintain adequate production and increase yields. Most of these are not absorbed by plants, so they settle in the soil and gradually filter through it, reaching groundwater. Similarly, these compounds can circulate through surface runoff and cause contamination problems in surface, fresh, or marine waters [3].

An excessive contribution of nutrients in surface waters, especially nitrogen and phosphorus, gives rise to a rapid proliferation of aquatic vegetation, as a consequence of oxygen depletion on the surface, which favors the appearance of eutrophication processes [4]. The Mar Menor (Region of Murcia, southeast of Spain) has been in the news in recent years due to the eutrophication, which refers to the processes of the ecosystem originated by the enrichment of nutrients of the water, especially nitrogen and/or phosphorus [5,6]. This situation, added to by the fact that most of the effluents from the wastewater treatment plants (WWTP) in this area are used for irrigation in agriculture, implies an increase in responsibility of the water industry to adopt a more sustainable management of urban water systems for this type of compound [7]. One of the most effective approaches to address this challenge of sustainability is wastewater treatment, in which water quality monitoring (WQM) plays a key role.

WQM can be described as a method for periodically sampling and analyzing water conditions and characteristics [8]. This method forms the basis for water environmental management, as it is vital to monitor source waters and the aquatic systems that receive inputs from industrial waste and sewage treatment plants, stormwater systems, and runoff from urban and agricultural lands [9]. Similarly, domestic sewage and water flows resulting from chemical processes and waste in industry and sanitation should be monitored in wastewater treatment plants that purify the water to decontaminate it before releasing it into the sea (or other large bodies of water), or be used for other applications such as irrigation, and to detect possible toxic or radioactive discharges.

OBJECTIVES:

These are some of the pretensions we want to achieve with our strategy for managing wastewater.

- Anzali Wetland water quality will be bettered and maintained at an ecologically sustainable position via the use of cost-effective wastewater treatment strategies.

STRATEGY

(1) Establishing Goals

Ambient water quality pretensions and contaminant cargo reduction pretensions for Anzali Wetland are established in the wastewater operation plan.

Ambient Water and Sediment Quality Objectives

pretensions for Anzali Wetland are established in the wastewater operation plan. Ambient Water and Sediment Quality With eutrophication forestall ment in mind, the operation of Anzali Wetland has established primary objects of COD 30 mg/ L, T- N2.0 mg/ L, and T- P0.20 mg/ L for ambient water quality. For environmental threat operation of heavy essence impurity, the following deposition quality objects have been established, grounded on the Canadian Environmental Quality Guidelines from 2002 Cd3.5 mg/ kg; Pb 91 mg/ kg; Cr 60 mg/ kg; Cu 197 mg/ kg; Zn 315 mg/kg. It's important to flash back that numerous rudiments affect the swamp terrain, thus setting an exact water quality that's safe for any specific species or niche might be difficult. Since organic pollution, eutrophication1, and the environmental troubles of heavy essence to the swamp ecology are particularly at play in the Anzali Wetland, these are the criteria chosen for study.

II. LITERATURE REVIEW:

Population growth coupled with a rising global norms of living has redounded into resource consumption including water use that exceeds the current resource of factory earth (Daigger, G.T, 2007), (Daigger,G.T, 2008) leading to product of waste water which when returned to the terrain exceeds the natural rate of recovering hence causal of water stress. Kenya is no exception when it comes to swell in population 2 as according to 2009 tale, population was estimated at 40 million people from 1999census of 28 million people. Water resource development and operation should be grounded on a participatory approach involving all applicable stakeholders for illustration, women plays a central part in provision, operation and securing water (ICWE, 1992). likewise, waste water operation development polices have to take place within a multi- stakeholder set up. thus, the strategic plans need to aim at achieving a sustainable and decent civic terrain in Kenya. The literal development of waste water operation has been characterized by the sweats to break substantially one problem at a time; sanitation during first half of 20th century followed by eutrophication of entering waters for the once ten or so times, recycling of nutrients. After the Dublin Conference of Water and Environment (ICWE), in Dublin Ireland in 1992, a reversal of the debate passed where water operation was bandied in a further holistic manner (ICWE, 1992). lately affiliated mega conferences emphasized integrated approach to water resource operation and the need to drastically reduce the number of people without acceptable access to water and sanitation services. In addition, the need for ecological responsibility has elicited different responses by government and cosmopolises. Stricter regulations have Redounded in huge investment in tertiary waste water treatment (WHO, 2000) The growth of Nairobi megacity has surpassed the rate at which structure is developed to meet the requirements of the growing population. Urbanization, population growth, and industrialization are putting enormous pressure on the Nairobi Rivers – Math are, Ngong, Athi and Kiu – the main source of water force for the megacity.

PROPOSED SYSTEM

An lcd displays the measured value after the waste water has been treated using an array of detectors that shoot their data to an Arduino uno board. We have created a coffee- budgeting system for IoT- grounded, real- time water quality monitoring. The planning system in this design makes use of an Arduino Uno as a central element, and an IoT-specific module is used to transmit detector data from the Uno to the cloud.

FEATURES

- Calibrated directly at ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee able (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Less than 60µA current drain
- Operates from 4 to 30 volts
- Low self-heating, 0.08°C in still air
- Low impedance output, 0.1 W for 1 mA load.

EXISITING SYSTEM

In the current setup, the snap regulator is employed simply, and the System may only be approved by a destined set of persons. The current medium prevents data from being participated across several individualities. There's a pause in entering the communication on the TV screen. Phytorid technology, which isn't automated, has been employed. Unreliable

results. There are still homemade way involved in drawing up wastewater. Ultrasonic and infrared detectors were employed in the history, but they snappily proved to be unreliable due to the extreme heat. Only a select many persons at a time may see the information on the LCD screen.

III. MOTIVATION OF RESEARCH:

Because it's essential to mortal survival, water must be defended for the coming generation. One of the most crucially critical systems needed is one that keeps tabs on water vacuity and quality. Water rates in India are formalized. The current water billing system has to be streamlined to take into account variables similar as water use, time of time, and end operation. The population's water use pattern must be delved in order to lessen water waste. The suggested system would Ensure that there's always water available from the valve. Repayment is included in the projected water bill. Water delivery prices are flexible and may be acclimated grounded on force and demand. Since the water would be readily accessible around the timepiece, there will be no need for people to store it in unsanitary conditions.

IV. SCHEMATIC CIRCUIT WITH ITS WORKING:

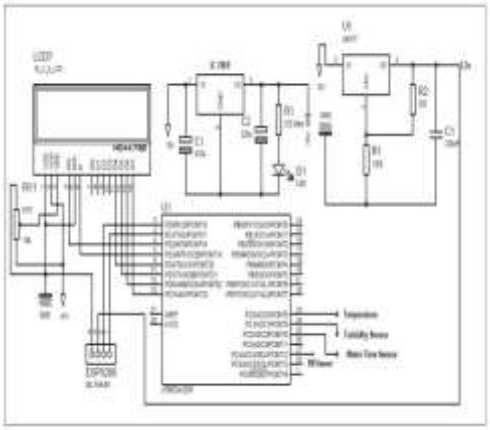
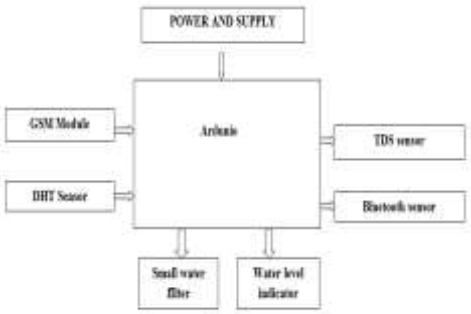


Fig1: schematic circuit

BLOCK DIAGRAM



HARD WARE COMPONENTS

Regulated power supply section

In mains- supplied electronic systems the AC input voltage must be converted into a DC voltage with the right value and degree of stabilization. In these introductory configurations the peak voltage across the cargo is equal to the peak value of the AC voltage supplied by the motor's secondary winding. For utmost operations the affair ripple produced by these circuits is too high. still, for some operations- driving small motors or lights, for illustration- they're satisfactory. If a sludge capacitor is added after the rectifier diodes the affair voltage waveform is bettered vastly. The section b- c is a straight line. During this time, it's the sludge capacitor that supplies the cargo current. The pitch of this line increases as the current increases, bringing point c lower. Accordingly, the diode conduction time (c-d) increases, adding ripple. With zero cargo current the DC affair voltage is equal to the peak value of the remedied AC voltage. Figure shows how to gain positive and negative labours appertained to a common ground. In particular they're helpful in determining the voltage ripple for a given cargo current and sludge capacitor value. The value of the voltage ripple attained is directly commensurable to the cargo current and equally commensurable to the sludge capacitor value. The performance of a force generally used in consumer operations – in audio amplifiers.

ARDUINO

Arduino Board

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, potterers, but also numerous professionals. People use it as smarts for their robots, to make new digital music instruments, or to make a system that lets your house shops chitter you when they 're dry. Arduinos (we use the standard Arduino Uno) are erected around an AT mega microcontroller basically a complete computer with CPU, RAM, Flash memory, and input/ affair legs, all on a single chip. Unlike, say, a jeer Pi, it's designed to attach all kinds of detectors, LEDs, small motors and speakers, servos,etc. directly to these legs, which can read in or affair digital or analogy voltages between 0 and 5 volts. The Arduino connects to your computer via USB, where you program it in a simple language (C/ C, analogous to Java) from inside the free Arduino IDE by uploading your collected law to the board. Once programmed, the Arduino can run with the USB link back to your computer, or stand- alone without it no keyboard or screen demanded, just power.

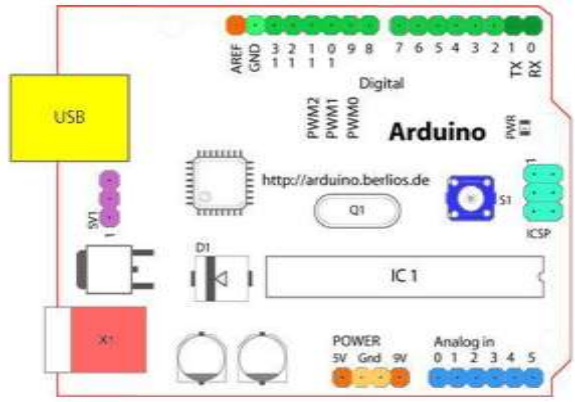


Figure 2 Structure of Arduino Board

GSM

GSM is a mobile communication modem; it's stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in 1970. It's extensively used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850

MHz, 900 MHz, 1800 MHz and 1900 MHz frequence bands.

GSM system was developed as a digital system using time division multiple access (TDMA) fashion for communication purpose. A GSM digitizes and reduces the data, also sends it down through a channel with two different aqueducts of customer data, each in its own particular time niche. The digital system has an capability to carry 64 kbps to 120 Mbps of data rates.

DHT sensor

Moisture is the measure of water vapour present in the air. The position of moisture in air affects colorful physical, chemical and natural processes. In artificial operations, moisture can affect the business cost of the products, health and safety of the workers. So, in semiconductor diligence and control system diligence dimension of moisture is veritably important. moisture dimension determines the quantum of humidity present in the gas that can be a admixture of water vapour, nitrogen, argon or pure gas etc moisture detectors are of two types grounded on their dimension units. They're a relative moisture detector and Absolute moisture detector. DHT11 is a digital temperature and moisture detector.

Bluetooth sensor

Bluetooth is a short- range wireless technology standard that's used for swapping data between fixed and mobile bias over short distances and erecting particular area networks (kissers). In the most extensively used mode, transmission power is limited to2.5 milliwatts, giving it a veritably short range of over to 10 metres (33 ft). It employs UHF radio swells in the ISM bands, from2.402 GHz to2.48 GHz. (3) It's substantially used as an volition to line connections, to change lines between near movable bias and connect cell phones and music players with wireless headphones.

IMPLIMENTATION

Rackling sludge It's a growth process in which microorganisms responsible for treatment are attached to an inert quilting material. It's made up of a round tank filled with a carrier material (stormy gemstone, clay or synthetic material). Wastewater is supplied from over and trickles through sludge media allowing organic material in the wastewater to be adsorbed by a population of microorganisms (aerobic, anaerobic, and facultative bacteria; fungi; algae; and protozoa) attached to the medium as a natural film or slime subcaste (roughly0.1 to0.2 mm thick). declination of organic material by the aerobic microorganisms in the external part of the slime subcaste occurs. As the subcaste thickens through microbial growth, oxygen cannot access the medium face, and anaerobic organisms develop. The natural film continues to grow to such a point that microorganisms near the face can not cleave to the medium, and a portion of the slime subcaste falls off the sludge. This process is known as sloughing. The sloughed solids are picked up by the underdrain system and transported to a purifier for junking from the wastewater (US EPA, 2000). Trickling pollutants are effective in that effluent quality in terms of BOD and suspended solids junking is high. Its functional costs are fairly low due to low electricity conditions. The process is simpler compared to actuated sludge process or some package treatment shops. Its operation

and conservation conditions are still grandly due to the use of electrical power. professed labour is needed to keep the trickling sludge running trouble-free help clogging, insure acceptable flushing, control sludge canvases. It's suitable for some fairly fat, densely peopled areas which have a sewerage system and centralized wastewater treatment; also suitable for greywater treatment. It also requires further space compared to some other technologies and has implicit for odour and sludge canvases (NPTEL, 2010). This system has been extensively used in Ghana. There are 14 trickling sludge shops in Accra though they've broken down.

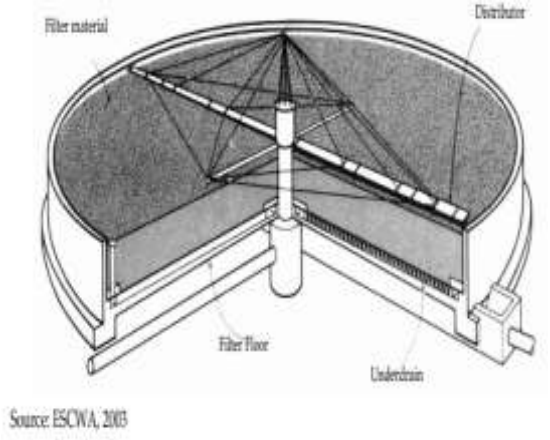


Fig. 3. Cross section of a trickling filter

Rotating biological contactors Rotating

Biological contactors (RBCs) correspond of vertically arranged, plastic media on a vertical, rotating shaft. The plastics range from 2 – 4 m in periphery and up to 10 mm thick (Peavy, Rowe announcement Tchobanoglous,1985). The biomass carpeted media are alternatively exposed to wastewater and atmospheric oxygen as the shaft sluggishly rotates at 1 –1.5 rpm (necessary to give hydraulic shear for sloughing and to maintain turbulence to keep solid in suspense), with about 40 of the media submerged. High face area allows a large, stable biomass population to develop, with redundant growth continuously and automatically exfoliate and removed in a downstream purifier. Consistence of biofilm may reach 2 – 4 mm depending on the strength of wastewater and the rotational speed of the fragment. RBC systems are fairly new, though it appeared to be stylish suited to treat external wastewater (Peavy, Rowe announcement Tchobanoglous, 1985), they've been installed in numerous petroleum installations because of their capability to snappily recover from worried conditions (Schultz, 2005). The RBC system is fluently expandable should the need arise, and RBCs are also veritably easy to enclose should unpredictable organic content constraint come necessary. RBCs have fairly low power conditions and can indeed be powered by compressed air which can also aerate the system. They follow simple operating procedures and therefore bear a relatively professed labour. RBCs are still capital ferocious to install and sensitive to temperature

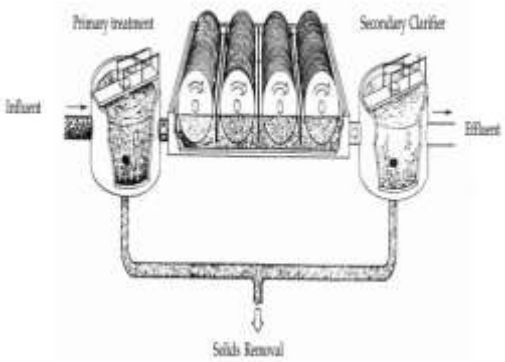
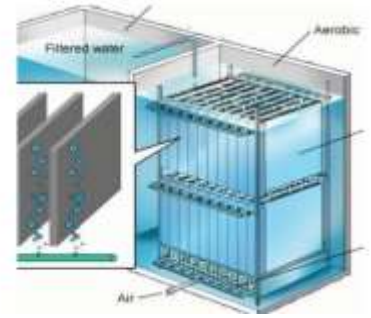


Fig.4. Source: ESCWA, 2003

Rotating Biological Contactors4.1.4 Membrane bioreactors This system performs further than just one treatment step. Membrane bioreactor (MBR) systems are unique processes, which combine anoxic- and aerobic- natural treatment with an intertwined membrane system that can be used with utmost suspended- growth, natural wastewater treatment systems.



Source: Google Images Fig. 15. Membrane Bioreactor

Wastewater is screened before entering the natural treatment tank. Aeration within the aerobic- reactor zone provides oxygen for natural respiration and maintains solids in suspense. MBR relies on submerged membranes to retain active biomass in the process. This allows the natural process to operate at longer than normal sludge periods (generally 20- 100 days for an MBR) and to increase mixed- liquor, suspended- solids (MLSS) attention (generally 8,000- 15,000 mg/ l) for further effective junking of adulterants. High MLSS attention reduce natural- volume conditions and the associated space demanded to only 20 – 30 of conventional natural processes. MBRs cover a small land area as it eliminates the need for secondary pollutants, which equates to a huge savings in both footmark and concrete costs. They can operate at advanced biomass attention (MLSS) than conventional treatment processes. Installation can be expanded by simply adding further membranes to being basins without expanding land cover. For exercise quality, it doesn't bear tertiary treatment, polymer addition, or any farther treatment processes to meet norms. This reduction in the number of unit processes further improves system trustability and reduces operation conditioning (TEC, 2010). The generally high effluent quality reduces the burden on disinfection in the treatment process.

Non-conventional methods

These are low- cost, low- technology, less sophisticated in operation and conservation natural treatment systems for external wastewater. Although these systems are land ferocious by comparison with the conventional high- rate natural processes, they're frequently more effective in removing pathogens and do so reliably and continuously if system is duly designed and not overfilled (FAO, 2006). Some of the non-conventional styles include stabilization ponds, constructed washes, oxidation gutter, soil aquifer treatment.

Waste stabilization ponds Waste

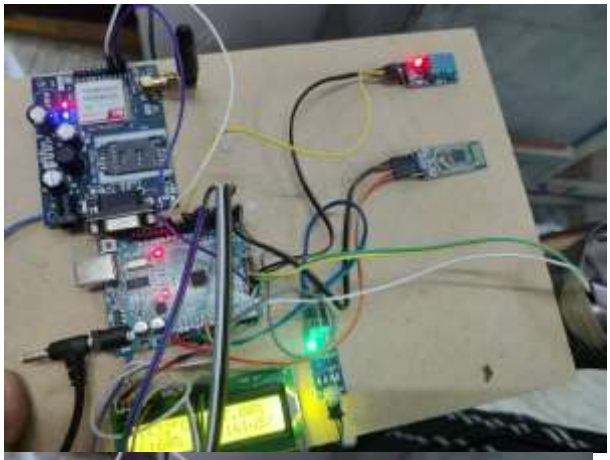
Stabilization Ponds are man- made, shallow basins which comprise of a single series or several series of anaerobic, facultative or development ponds. This is a low- technology treatment process with 4 or 5 pounds of different depths with different natural conditioning. Treatment of the wastewater occurs as ingredients are removed by sedimentation or converted by natural and chemical processes (National Academy, 2005). The anaerobic ponds are substantially designed for the settling and junking of suspended solids as well as the breakdown of some organic matter (BOD5). In facultative ponds, organic matter is farther broken down to carbon dioxide, nitrogen and phosphorous by using oxygen produced by

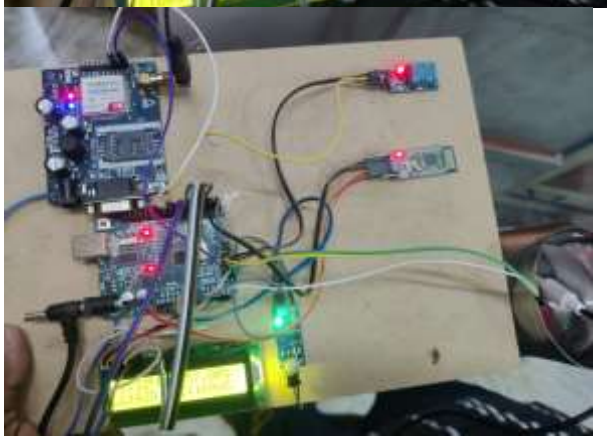
algae in the pond. Development ponds generally remove nutrients and pathogenic microorganisms, therefore primary treatment occurs in anaerobic ponds while secondary and tertiary treatment occurs in facultative and development ponds independently (Awuah, 2002). Anaerobic ponds are generally between 2- 5 m deep and admit high organic loads original to 100g BOD5 and m3/ d leading to anaerobic conditions throughout the pond (Mara etal., 1992). still, anaerobic ponds can remove 60 of BOD5 at 200 C, If duly designed. Facultative ponds are 1- 2 m deep and generally admit the effluent from an anaerobic pond. In some designs, they admit raw wastewater acting as primary facultative pond. In facultative ponds organic loads are lower and allows for algal growth which accounts for the dark green colour of wastewater. Algae and aerobic bacteria induce oxygen which breaks down BOD5. Good wind haste generates mixing of wastewater in ponds therefore leading to invariant mixing of BOD5, oxygen, bacteria and algae which better stabilizes waste.

Future scope

unborn compass in perpetration of this design, the stopcock was controlled manually and also Arduino Uno and Arduino were used together for perpetration of the design. So furtherly design can be developed with Wi- Fi Module Arduino Uno alone and perpetration of automatic stopcock control can be done. also, the design can make use of a gas detector to descry the gas position, which may help sewage workers to decide whether it's safe to work in the terrain or not.

V. OUTPUTS :





Faecal sludge treatment and disposal Sewage sludge contains organic and inorganic solids that were set up in the raw wastewater. Sludge from primary and secondary purifier as well as from secondary natural treatment need to be treated. The generated sludge is generally in the

form of a liquid or semisolid, containing0.25 to 12 per cent solids by weight, depending on the treatment operations and processes used. Sludge is treated by means of a variety of processes that can be used in colorful combinations. Thickening, conditioning, dewatering and drying are primarily used to remove humidity from sludge, while digestion, composting, incineration, wet- air oxidation and perpendicular tube reactors are used to treat or stabilize the organic material in the sludge (ESCWA, 2003).Thickening is done to increase the solids content of sludge by the reduction of the liquid content. An increase in solids content from 3 to about 6 per cent can drop total sludge volume significantly by 50 per cent. Sludge thickening styles are generally physical in nature they include graveness settling, flotation, centrifugation and graveness belts.

Challenges of wastewater management

Wastewater operation though not technically delicate can occasionally be faced with socio- profitable challenges. A many of the challenges are bandied below.

Infrastructure

Most frequently than not, wastewater structure isn't the precedence of utmost politicians and thus veritably little investment are made. It's still important to consider wastewater structure as inversely important as water treatment factory because nearly all the water produced ends up as wastewater. Pollution of water sources goods of wastewater effluent on entering water quality is enormous, it changes the submarine terrain therefore interrupts with the submarine ecosystem. The food we eat contains carbonaceous matter, nutrients, trace rudiments and mariners and are contained in urine and faeces (black water), specifics (medicines), chemicals and in recent times hormones (contraceptives) are also discharged into the wastewater treatment factory. Discharge guidelines must be rigorously stuck to. This will insure sustainability of water sources for offspring The preventative and the polluter- pays principles which help or reduce pollution to the wastewater have proven to be veritably effective in the industrialized countries and should be acclimated in developing countries as well.

Choice of appropriate technology

Because the frugality of utmost developing countries is patron driven, finances for wastewater shops are substantially from benefactors. For this reason, they tend to propose the technology which should be espoused. For this reason, when the heirs, take over the installation, its operation of the operations and conservation of corridor come relatively grueling as the specialized moxie, power conditions etc aren't sustainable.

Sludge production

Treatment of wastewater results in the product of sewage sludge. There must be a dependable disposal method. However, also the pitfalls involved must be taken into consideration, If it must be used in husbandry. Due to the presence of heavy essence in wastewater, it's occasionally stressed that agrarian use may lead to accumulation of heavy essence in soils thereby polluting of yields.

RESULT:

Backwaters which meet discharge norms could be used for agrarian purposes similar as monoculture or for irrigation of spreads. The challenge still is that if wastewater treatment shops aren't managed and continuously covered to insure good effluent quality, exercise becomes parlous.

VI. CONCLUSION:

Wastewater is and will always be with us because we can not survive without water. When water supplied is used for the multitudinous mortal conditioning, it becomes polluted or its characteristics is changed and thus come wastewater. Wastewater can and must be treated to ensure a safe terrain and foster public health. There are conventional and non-conventional styles of wastewater treatment and the choice of a particular system should be grounded on factors similar as characteristics of wastewater whether it from a megacity or assiduity (chemical, cloth, pharmaceutical etc.), specialized moxie for operation and conservation, cost counter accusation, power conditions among others. In utmost developing countries like Ghana, low- cost, low- technology styles similar as waste stabilization ponds have been successful whilst conventional styles like trickling pollutants and actuated sludge systems have broken down. Effluent which meets set discharge norms can be meetly used for monoculture and also irrigation. Though there are many challenges in waste water operation, they can be surmounted if attention and the necessary fiscal support is given to it.

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