Activated Sludge Process Overview

B. Ahansazan, H. Afrashteh, N. Ahansazan, and Z. Ahansazan

Abstract—**In recent years the waste water ministerial regulations have led to a constant ascend in the purification performance demanded of waste water treatment plants. Because of this, the number of waste water treatment plants has been maturing, and technical complexity has also been growing. In order to hold the connected rising costs of capital expenditure and operation within bounds, sagacious process technology solutions have to be found. Besides having a deeper understanding of the individual processes, it is indispensable to consider the entire waste water treatment plant as a whole. Most treatment plants consist of a mechanical and biological waste water purification, sludge treatment and gas utilization. In three of these four stages, namely in the preliminary and secondary clarification of the waste water and in the thickening and dewatering of the sludge, the processes for solids/liquids separation are of crucial importance.**

The efficiency of the solids/liquids separation is mainly influenced by the properties of the sludge.

***Index Terms*—Activated sludge, wastewater, microorganisms, treatment process**

I. Introduction

The Activated Sludge (AS) process was expanded as an intermittent to biological filters, and is particularly beneficial for large populations where land is at a premium. More recent research however, has shown that the process can be acted in many different modes, manufacturing it a more flexible process than biological filtration [1]. The Activated Sludge process is apeltednatural biological treatment process. It is a complex mix of microbiology and biochemistry importing many different sorts of bugs. In the Activated Sludge Plant (ASP) bacteria secrete adhesive substances that clothe the minute particles carried in sewage. The particles stick together to form flocks of gel-like material, creating a support on, and in which, the bugs exist. This is the chocolate-brown colored activated sludge. The activated sludge is aerated to dissolve oxygen which allows the organic matter (BOD) to be utilized by the bugs. The organic matter, or food, cohesions to the activated sludge. The oxygen dissolved in the water allows the bugs to usage the food (BOD) and also to change the ammonia to nitrate. The tank should be big sufficient to allow sufficient contact time (retention time) between the sewage and the activated sludge for all the chemical changes to take place [2], [3].

Manuscript received June 1, 2013; revised September 3, 2013.

B. Ahansazan, H. Afrashteh, N. Ahansazan, and Z. Ahansazanare with Ministry of Science, Research and Technology of Iran. Valiasr Technical College of Tehran, Iran (e-mail: b.ahansazan@yahoo.com).

II. Biological Processes

A. Biological Treatment by Activated Sludge

Wastewater achieves from two major sources: as human sewage and as process waste from making industries. In the UK, the total volume of wastewater from industry is about 7 times that of household sewage. If untreated, and dismissed directly to the environment, the receiving waters would become polluted and water-borne illness would be widely diffused. In the early years of the twentieth century the method of biological treatment was invented, and now forms the basis of wastewater treatment worldwide[1]. It simply imports confining naturally occurring bacteria at very much higher concentrations in tanks. These bacteria, together with some protozoa and other microbes, are collectively concerned to as activated sludge. The construct of treatment is very simple. The bacteria remove small organic carbon molecules by ‘eating’ them. As a result, the bacteria flourish, and the wastewater is cleansed. The treated wastewater or effluent can then be discharged to arriving waters – normally a river or the sea [2].

Whilst the concept is very simple, the control of the treatment process is very abstruse, because of the large number of variables that can affect it. These include changes in the combination of the bacterial flora of the treatment tanks, and changes in the sewage passing into the plant [3]. The influent can show variations in flow rate, in chemical composition and pH, and temperature [4]. Many urban plants also have to contend with surge flows of rainwater following storms. Those plants receiving industrial wastewater have to cope with rebellious chemicals that the bacteria can decline only very slowly, and with toxic chemicals that debar the functioning of the activated sludge bacteria. High concentrations of toxic chemicals can output a toxic shock that kills the bacteria. When this happens the plant may transit untreated effluent direct to the environment, until the dead bacteria have been eliminated from the tanks and new bacterial ‘seed’ introduced[2] ,[5].

Globally, the combination of effluents dismissed to receiving waters is regulated by the national environment agencies. In Europe the regulatory regulation is the Urban Waste Water Treatment Directive (1991) and the more recent Water Framework Directive (2000). In the USA, the Environmental Protection Agency (EPA) certifies compliance with the Clean Water Act (1977). The law is concerned with the forbidding of pollution, and therefore sets concentration limits on dissolved organic carbon (as BOD or COD), nitrogen and phosphates – which cause eutrophication in achieving waters. It also attempts to bound the separated of known toxic chemicals by setting allowable concentration limits in the effluent [2],[4]. Recently, in distinction that effluents contain unknown toxic chemicals, a more practical approach to adjustment is being introduced

DOI: 10.7763/IJESD.2014.V5.455

in Europe, using Direct Toxicity Assessment (DTA) tests. In the US these have been in usage for many years and are known as Whole Effluent Toxicity (WET) tests. These tests are used to measure the toxic factors of effluents on representative organisms from the receiving waters. Any toxicity observed in the effluents will obviously have been extant in the sewage entering the plant. Surprisingly, direct toxicity assessment of influents to wastewater treatment plants that could hit on the functioning of the bioprocesses is not yet included in legislation [2],[3],[6].

B. The Nature and Composition of Wastewater

Domestic sewage is constituted largely of organic carbon, either in solution or as particulate matter. About 60% is in particulate form, and of this, slightly under a half is large adequate to settle out of suspension. Particles of 1nm to 100µm remain in colloidal suspension and pending treatment become adsorbed on to the flocks of the activated sludge [2], [3].

The bulk of the organic matter is easily biodegradable, including of proteins, amino acids, peptides, carbohydrate, fat and fatty acids. The average carbon to nitrogen to phosphorus ratio (or C: N: P ratio) is diversely stated as approx 100: 17: 5 or 100: 19: 6. This is close to the ideal for the growth of the activated sludge bacteria. However, industrial wastewaters are very much more variable in combination. Those manufactured by the brewing, and pulp and paper industries, for example, are deficient in nitrogen and phosphate. These nutrients need to be added therefore to attain the correct ratio for microbial growth, and to allow treatment to proceed optimally[2],[3],[5],[7].

C. Degradable and Non-Degradable Carbon

For control of the biological processes in a treatment plant, it is essential to have some knowledge of the organic strength, or organic load, of the influent wastewater. Three different measures of this are usable, and they each have their merits and weaknesses. The Total Organic Carbon (TOC) is being analytic straightforward to measure. It includes oxidation by combustion at very high temperatures and module of the resultant CO2. However, TOC values comprise those stable organic carbon combination that cannot be broken down biologically [1]-[3].

Organic carbon can also be calculated by chemical oxidation. The sample is heated in strong sulphuric acid containing potassium dichromate, and the carbon oxidised is specified by the amount of dichromate used up in the reaction [2], [7]. The result is represent in units of oxygen, rather than carbon, and the procedure is referred to as the Chemical Oxygen Demand (COD). Again it is an analytically simple method. However, its weakness is that a number of indomitable organic carbon combination that are not biologically oxidisable, are contained in the value obtained. Conversely, some aromatic combination, including benzene, toluene, and some pyridines, which can be broken down by bacteria, are only partly oxidised in the COD method. Overall however, COD will overrate the carbon that can be removed by the activated sludge[2],[4],[5],[8].

The current method used to define the biodegradable carbon, is the 5-day Biological Oxygen Demand (BOD5). This is a measure of the oxygen uptake over a 5-day period by a small 'seed' of bacteria when limited, in the dark, in a bottle containing the wastewater. During this time the biodegradable organic carbon is derived, and there is a corresponding 4 reduction in the dissolved oxygen, as some of the carbon is used for the aspiration of the bacteria [2],[3]. Rather unhelpfully, the biodegradable carbon, as in the COD test, is represent in oxygen units. This is because the test was originally reported to measure the oxygen evacuation in receiving waters effected by the residual degradable carbon in the effluent. Its main value is in adjusting the composition of effluents from the treatment water. For process management, where knowledge of the organic loading of the influent is needed, BOD5 is of feinted value, because of the 5 days necessary to make the measurement. There are now moves afoot to change the use of BOD5 as a measure of influent strength, with a short-term test (BODST), which can be bearer out over a timescale of 30 minutes to several hours [2],[4],[6],[7].

The values received for BOD5 are always lower than those for COD, for 2 reasons:

- Activated sludge bacteria cannot degrade some of the combination oxidized chemically in the COD test.
- Some of the carbon eliminated during the BOD test is not oxidized, but ends up in new bacterial biomass. So the BOD is only measuring the biodegradable carbon that is really oxidized by the bacteria [1],[2].

The ratio of BOD5/COD will appertain the composition of the wastewater. For household sewage, and also the wastewaters from the slaughterhouse, dairy, distillery and rubber industries, the ratio is about 0.5 - 0.6. However, for sewage leaving the treatment plant, it is closer to 0.2. This is because the readily biodegradable organic carbon has been deleted during treatment, departing behind the compounds that are not readily broken down by the bacteria – 'hard' BOD. These will be readily measured by chemical oxidation, but will not be readily degraded and eliminated by the bacteria in the BOD bottle [1]-[4].

III. The Composition of Activated Sludge

A. Activated Sludge Bacteria

The activated sludge of the aeration laver of a wastewater treatment works is a complex ecosystem of competing organisms. The dominant organisms are the bacteria, of which there may be 300 species ubiquitous. Bacteria are amongst the smallest and most abundant living organisms. Each comprises a single cell varying in size from about 0.5 – 2 µm. On the outside, the cell is bounded by membranes that adjust the inflow of ions and molecules from the surrounding water. This, in turn is surrounded by a hardcell wall, created of a sugar polymer. The interior of the cell contains the cytoplasm and the thousands of different chemicals whose reactions are regulated by enzymes. The bacterial cell does not have a nucleus. Most bacteria are orbicular, but some may be rod shaped or have a spiral form. Filamentous bacteria contain long chains of small bacterial cells, sometimes surrounded by a tubular sheath, and can reach lengths of 100µm.[2],[3],[5].

Small molecular weight compounds spread into the bacteria (ingestion) through the cell wall. At the same time, some larger complex molecules that have been synthesized within the bacteria, pass outwards. This process is referred to as secretion [2], [3].

The secretions include slimes and gels that may bond the bacteria together and also enzymes. The enzymes break down large organic molecules into smaller monomers that are small sufficient to be ingested [2].

The bacteria use the ingested molecules for the synthesis of new molecules, in the process of growth. When they have attained normal size, the bacterium divides into two, and the process is repeated. If nutrient molecules are not limiting, this results in progressive growth in the numbers of bacteria [2].

The bacteria in a wastewater treatment plant included both heterotrophy and autographs. The heterotrophic or carbonaceous bacteria are the dominant group of organisms. They are characterized by nutrition mainly on organic carbon molecules rather than inorganic ones. By mutuality, the autographs take in inorganic chemicals, and use these in the synthesis of organic compounds. The nitrifying bacteria that remove ammonia from the wastewater are the most significant of this group. There are relatively few species of autographs, and since they have low growth rates, they tend to be out- emulated by the faster-growing heterotrophy[2],[3],[5].

IV. The Biological Basis of Wastewater Treatment

Activated sludge is a suspended growth secondary treatment process that primarily removes dissolved organic solids as well as settle-able and non-settle-able suspended solids. The activated sludge itself includes of a concentration of microorganisms and sludge particles that are naturally found in raw or settled wastewater. These organisms are *cultivated* in aeration tanks, where they are provided with soluble oxygen and food from the effluent. The term "activated" comes from the fact that the particles are teeming with bacteria, fungi, and protozoa.[1],[2],[9].

Like in most other wastewater treatment plants, when wastewater enters an activated sludge treatment facility the preliminary treatment processes eliminate the coarse or heavy inorganic solids (grit) and other debris, such as rags, and boards. Primary clarifiers (if they are provided) remove much of the floatable and settle able organic material. The activated sludge process can treat either primary clarified.[2],[5],[9].

Wastewater or raw wastewater immediately from the preliminary treatment processes. As the wastewater enters the aeration basin, the activated sludge microbes use the solids in the wastewater. After the aeration basin, the wastewater solids and microorganisms are separated from the water through gravity settling which occurs in a secondary clarifier. The settled solids and microorganisms are pumped back to the front of the aeration basin, while the clarified water flows on to the next component [1],[2],[9],[10].

Scheme of the activated sludge system is shown in Fig. 1.

A. *Providing Controllable Influent Feeding*

The feeding of wastewater to activated sludge systems must be controlled in a manner that certify even loading to all of the aeration basins in operation. Well-designed flow splitter boxes should be accommodate into the front of the aeration basin and they should be checked periodically to ensure that the flow distribution is split as intended [2]. In some situations, it is desirable to feed wastewater throughout various points in the aeration basin. This is known as step feeding. Step feeding is one method of relieving the high oxygen demand that can befall where the influent flow and RAS enter the aeration basin. However, a downside to step feeding is that some of the soluble solids in the influent may pass through the aeration basin too rapidly, and show up in the effluent as BOD [1],[9],[10].

B. *Maintaining Proper Dissolved Oxygen and Mixing Levels*

Activated sludge microorganisms need oxygen as they oxidize wastes to receive energy for growth. Insufficient oxygen will slow down or kill off aerobic organisms, make facultative organisms work less efficiently and ultimately lead to the production of the foul-smelling by-products of anaerobic analysis. As the mass of organisms in an aeration tank increment in number, the amount of oxygen needed to support them also increases. High concentrations of BOD in the influent or a higher influent flow will increment the activity of the organisms and thus augmentation the demand for oxygen. Sufficient oxygen must always be maintained in the aeration tank to ensure complete waste stabilization. This means that the level of oxygen in the aeration tank is also one of the critical controls available to the operator. A minimum dissolved oxygen (D.O.) level of 1.0 mg/L is counsel in the aeration tank for most basic types of activated sludge processes. Maintaining > 1.0 mg/L of D.O. contributes to establishing a favorable environment for the organisms, which produces the desired type of organism and the eligible level of activity. If the D.O. in the aeration tank is allowed to drop too low for long periods, undesirable organisms, such as filamentous type bacteria may expand and overtake the process. Conversely, D.O. levels that are allowed to rise too high can cause problems such as flock particles being floated to the surface of the secondary clarifiers. This problem is particularly common pending cold weather. For these reasons it is important that the proper dissolved oxygen levels be maintained in the aeration basin. This needs routine monitoring by the system operator using a D.O. meter[8]-[10].

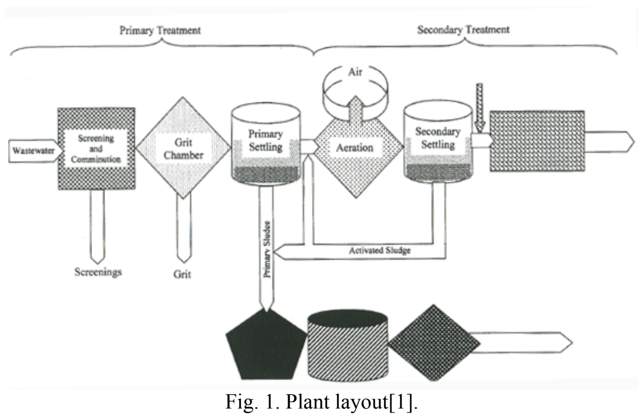

Fig. 1. Plant layout[1].

C. Describe the Characteristics of Healthy Activated Sludge

The color of healthy activated sludge is tan to brown. It would have anterrestrial odor. During a 30 minute settling test, the settled sludge volume would be 200-300 mL/L. The SVI would be 80-150. The supernatant would be clear with little or no flock particles. Sludge age for formal systems would be 3-10 days and 15-30 days for extended aeration systems [1]-[3].

1) Discuss the characteristics of young and old activated sludge:

a) Young sludge

Young sludge includes of sludge which has not yet reached a high enough sludge age to be most impressive in a particular activated sludge process. Billowing whitish foam is an index that the sludge age is too low. Young sludge will often have poor settling characteristics in the clarifier, and can leave straggler flock in the clarifier effluent. Young sludge is often affiliate with a high F/M. To correct for young sludge it is needful to reduction wasting rates. This will increment the amount of solids under aeration, detract the F/M ratio, and increase the sludge age[2],[4].

b) Old Sludge

Old sludge comprises of sludge in which the sludge age is too high to be most efficient in a particular activated sludge process. Dark brown foam and a somewhat greasy or scummy appearance is an indicator of old sludge. Settling in the clarifier is fast, but pin flock can be existent in the effluent and the effluent is hazy. Old sludge is often associated with a low F/M ratio. To accurate for old sludge, it is necessary to increment wasting rates and return less sludge to the aeration basin. This will decrease the amount of solids under aeration, augmentation the F/M ratio and decrease the sludge age [2],[4].

D. Controlling the RAS Pumping Rate

The amount of time that solids expend on the bottom of the secondary clarifier is a function of the RAS pumping rate. The settled microorganisms and solids are in a embitter condition as long as they remain in the secondary clarifier. If sludge is allowed to remain in a secondary Separator too long it will begin to float to the surface of the clarifier due to nitrogen gas assert during the biological process ofde-nitrification (rising sludge)[9], [10]. Monitoring and controlling the depth of the sludge blanket in the secondary Separator and the concentration of solids in the RAS are significant for the proper operation and control of the activated sludge system. A sludge settle-ability test, known as a settle meter, can be used to indication the rate of sludge settling and compaction. This information is used to detest appropriate RAS pumping rates. Typically, RAS pumping rates of between 25% and 150% of the influent flow are commonly used. Measuring the solids concentration of RAS allows the return volume to be regulated to keep the solids level in the aeration basin within the control parameters. Excess sludge which eventually cumulates beyond that rebounded is specified as Surplus or Waste Activated Sludge (SAS/WAS). This is removed from the treatment process to keep the ratio of biomass to food conveyed (sewage or wastewater) in balance [8]-[10].

E. Maintaining the Proper Mixed Liquor Concentration

The activated sludge process is a physical/ biological wastewater treatment process that uses microorganisms to segregate wastes from water and to facilitate their decomposition. When the microorganisms in activated sludge come into contact with wastewater, they feed and grow on the waste solids in the wastewater. This mixture of wastewater and microorganisms is known as mixedliquor. As the mixed liquor flows into a secondary clarifier, the organism's activity slows and they begin to aggregation together in a process known as bio-flocculation i.e. the ability of one flock particle to stick to another. Because the velocity of the water in the secondary clarifier is very low, the flocculated clumps of organism settle to the bottom of the clarifier (as sludge), while the clarified water currents over a weir. The settled organisms are constantly pumped back to the front of the aeration laver to treat more waste [8]-[10].

This is called reflux activated sludge, or RAS, pumping. The clarified effluent is typically deodorized and then discharged from the facility. As the organisms in the aeration basin capture and treat wastes they grow and rehabilitate and more and more organisms are created. To function efficiently, the mass of organisms (solids concentration) needs a steady balance of food (wastewater solids). If too many organisms are allowed to grow in the aeration basin, there will not be sufficient food for all of them. If not adequate organisms are present in the basin, they will not be able to consume the available food and too much will be lost to the effluent in the form of BOD and TSS. This balance between the available food (F) and the mass (M) of microorganisms is explained as the F:M ratio of the system. The job of an activated sludge wastewater treatment plant operator is to hold the correct mass of microorganisms for the given food supply. Because the food supply does not typically change very much (that is, the amount of wastewater solids usually stays the same from day to day), operators must regulate the mass of organisms that are allowed to agglomerate in the aeration basin. This adjustment is constructed by removing or *wasting* organisms out of the system. Sludge that is intentionally eliminated from the activated sludge process is referred to as waste activated sludge, or simply as WAS. Activated sludge provides treatment through the oxidation and dissociation of soluble organics and finely divided suspended materials that were not removed by previous treatment. Aerobic organisms carry out the process in a matter of hours as wastewater flows through the aeration tank and secondary clarifier [6], [10]. The organisms stabilize soluble organic material through partial oxidation resulting in energy for the organisms and by-products, such as carbon dioxide, water, sulfate and nitrate compounds. Finely divided suspended solids such as colloids are snared during bio-flocculation and thus removed during clarification. Conversions of dissolved and suspended material into settle able solids as well as oxidation of organic substances (digestion) are the major objectives of the activated sludge process. High rate activated sludge systems tend to treat waste through transformation of the dissolved and settle able solids while low-rate processes rely more upon oxidation of these solids into gasses and other compounds. Oxidation is carried out by chemical processes, such as direct oxidation from the soluble oxygen in the aeration laver, as well as through biological processes [7]-[10].

Microorganism capture much of the dissolved organic solids in the blended liquor rapidly (minutes), however, most organisms will need a long time to metabolize the food (hours). The concentration of organisms increase with the waste load and the time spent augmentations in the aeration tank. To sustain favorable conditions, the operator will remove the excess organisms (waste sludge) to sustain the required number of workers for effective treatment of the waste [9], [10]. The mass of organisms that the operator maintains is a function of the mixed liquor suspended solids (MLSS) concentration in the aeration basin. By lowering the MLSS concentration (increased wasting), the operator can decrease the mass of organisms in the system. This effectively elevations the F:M ratio of the system. By enhance the MLSS concentration (reduced wasting), the operator can augmentation the number of organisms in the system available to provide treatment. This has the effect of lowering the F:M ratio. Again, controlling the rate of sludge wasting from the treatment process is one of the significant control factors in the activated sludge system [7]-[10].

F. Measure importance of MLLS

If MLSS content is too high

–The process is prone to bulking and the treatment system becomes overloaded

–This can cause the dissolved oxygen content to drop with the effect that organic matters are not fully degraded and biological 'die off'

–Excessive aeration required which wastes electricity

If MLSS content is too low

–The process is not operating efficiently and is wasting energy.

V. CONCLUSION

In the last years, new treatment methods such as chemical oxidation, granular activated carbon adsorption, powdered activated carbon treatment, wet-air oxidation, and anaerobic treatment methods have been improved for the treatment of wastewaters containing refractory compounds.

Based on the knowledge about the effectiveness of microorganisms in the bioremediation of persistent organics-contaminated soil and especially groundwater environments by increasing the bioavailability of these contaminants to microorganisms, it was considered that bacteria might have an enhancement effect on the biodegradation of persistent organic contaminants in industrial wastewaters.

Biological treatment methods have been often considered as the most complete, environmentally acceptable and cost-effective treatment options. The presence of refractory or toxic pollutants in the wastewaters often hinders treatment of these wastewaters through the biological processes.

REFERENCES

[1] M. Gros, M. Petrovic, A. Ginebrada, and D. Barcelo, "Removal of pharmacaceutical during wastewater treatment and environmental assessment using hazard indexes,"*Environmental International.*, vol 36, pp. 24-26, 2010.

[2] Biological Wastewater Treatment. [Online]. Availible: http://www. engineering.dartmouth.edu/ Cushman/…/Bio Treatment Types.pdf

[3] M. H. Esparza, M. C. Doria-Serrano, G. Acero-Salinas, F. A. Ruiz-Trevino, "Removal of high phenol concentrations with adapted activated sludge in suspended form and entrapped in calcium alginate /cross-linked poly(N-vinyl pyrrolidone) hydrogels," *Biotechnology Process*, vol. 22, pp. 1552-9,2006.

[4] APHA. *Standard Methods for the Examination of Water and Wastewater,* 20th Ed., Washington, D.C., American Public Health Association, 1998.

[5] S. Yi, W. Q. Zhuang, B. Wu, S. T. L. Tay, and J. H. Tay, "Biodegradation of p-Nitrophenol by Aerobic Granules in a Sequencing Batch Reactor," *Environ. Sci. Technol.,* vol. 40, pp. 2396-2401, 2006.

[6] L. L. D. Oliveira, I. C. S.Duarte, I. K. Sakamoto, and M. B. A. Varesche, "Influence of support material on the immobilization of biomass for the degradation of linear alkylbenzenesulfonate in anaerobicreactors," *J. Environ. Manage.*, vol. 90, pp 1261-1268, 2009.

[7] E. Smulders, W. von Rybinski, E. Sung, W. Rähse, J. Steber, F. Wiebel, and A. Nordskog, "Laundry Detergents," *Ullmanns Encyclopedia of Industrial Chemicals,*2007.

[8] S. S. Adav. M. Y. Chen. D. J. Lee, and N. Q. Ren, "Degradation of phenol by aerobic granules and isolated yeast *Candida tropicalis*," *Biotechnol. Bioeng*., vol. 96, pp.844-852, 2007.

[9] A. Sacramento, "Operation of wastewater treatment plants," *Office of Water Programs*, vol. 5-8, California State University, 1970.

[10] A. Sacramento, "Operation of wastewater treatment plants," *Office of Water Programs*, vol. 11, California State University, 1970.

Batool Ahansazan was born on Aug 10, 1983, Tehran, Iran. She was graduated of Sciences at Valiasr Technical College of Tehran. Chemical Industries Tehran, Iran, 1998-2003. She is student in the master's degree in Energy Engineering at Science and Research Branch, Islamic Azad University(IAU) She is a LECTUERER in Valiasr Technical College of Tehran, Iran. Her research in the field of nanotechnology and water treatment systems.

Ms. Batool Ahansazan is a member of Iranian Association of Chemical Engineers and Iranian Society of Mechanical Engineers.

Narges Ahansazan was born on March 21, 1987, Tehran, She was graduated of Sciences at Islamic Azad University (IAU), Industrial engineering, Tehran, Iran, 2005-2010.

She is an Industrial engineer in Arian Distribution Company as a Supply Chain Manager. She is a member of Iranian Association of Industrial Engineers.

Zahra Ahansazan was born on June 26, 1989, Tehran, Iran. She is student Electrical engineering, electronicstrends at Islamic Azad University (IAU).

She is Electronics Engineer in Limenics Company. She is a member of Iranian Association of electronics Engineers.

Hossein Afrashteh was born on Aug 19, 1986, Tehran, Iran. He was graduated of Sciences at Islamic Azad University (IAU), Industrial engineering, Tehran, Iran, 2005-2011.

He is an Industrial engineer in Afra Sanitary Faucets. He is a member of Iranian Association of Industrial Engineers.