

Electronic system to save water due to their decrease in Mexicali by the coating of the all American canal in USA

Gustavo López Badilla¹, Elizabeth Romero Samaniego², Sandra Luz Toledo Perea², Miriam Maleni García Castrellon³, Luis Alberto Gameros Rios³

¹ Investigador-Académico del Instituto Tecnológico de Mexicali (ITM), Mexicali.

² Investigador-Académico del Instituto Tecnológico de Ensenada (ITE), Ensenada.

³ Alumnos de la Carrera de Ingeniería Industrial del Instituto Tecnológico de Mexicali (ITM), Mexicali.

Paper received on 06/10/12, Accepted on 25/10/12.

Abstract. Efficient use of water is an essential part in the development of the entire area of each country. We consider the implementation of automated systems to maintain adequate fluid flow to vital activities performed in each area of a city or the countryside. The main automated control systems are developed with basic electronic devices coupled application geese sometimes complex components or systems; the cost should not be too high and be developed in an easy, to be operated quickly and easily. In cities or regions of the world where you have water shortages, government authorities are working flat out to supply water to reduced or restricted. In this research project is evaluated considering the issue of the possible restructuring of the All American canal coming from the northern United States (Wyoming), through Mexico and southern reaches of the continent. The U.S. government intends to take the channel, which involves placing a foundation plate, whereby certain areas of the border region of Baja California and California, they have problems of lack of precipitation into the ground and thus not to generate wells in Mexicali valley regions, where water is drawn for supply to farms. Efficient use of water is an essential part in the development of the entire area of each country. We consider the implementation of automated control systems (ACS) to maintain adequate fluid flow to vital activities performed in each area of a city or the countryside. The main automated control systems are developed with basic electronic devices coupled application geese sometimes complex components or systems; the cost should not be too high and be developed in an easy, to be sold quickly and easily. In cities or regions of the world where you have water shortages, government authorities are working flat out to supply water to reduced or restricted. In this research project is evaluated considering the issue of the possible restructuring of the All American canal coming from the northern United States (Wyoming), through Mexico and southern reaches of the continent. The U.S.

government intends to take the channel, which involves placing a foundation plate, whereby certain areas of the border region of Baja California and California, they have problems of lack of precipitation into the ground and thus not to generate wells in Mexicali valley regions, where water is drawn for supply to farms.

Keywords. Electronic systems, save water, All American canal, control systems

Introduction

The efficient use of water is important in the development of any country. To maintain an ecological behavior to water saving in any region is necessary install ACS. The northwest of Mexico, where they are located cities in Sonora as San Luis Rio Colorado (SLRC) and Mexicali in Baja California, are desert areas that require water for domestic, industrial and agricultural activities. For this reason, we propose the use of ACS to save water with electronic devices at low costs. This study was performed from 2007 to 2011 to support to people in the cities mentioned above. People of SLRC and Mexicali, is concerned because water levels will be decrease in the next five years by the covering of the All American Canal, which is a source to this region. When people use polluted water as water recycled of agricultural operations to domestic activities generate stomach and respiratory infections. The reduction of water in underground aquifers (UA) in this region, damage the soil and generate environmental deteriorate and droughts that affect the agricultural and economic operations [1].

1. The use of water

Experts in the field of water protection, think that water shortages in some countries have a negative effect in the health of people. The World Health Organization (WHO) indicates that more than half the world population is victim of water scarcity, which has contributed to climate change in some regions and the generation and propagation of actual and new diseases [2]. In Mexico some regions has by water shortages and decrease the productivity in agricultural, commercial and industrial operations. The northwest of Mexico is prone to suffer the negative effects of water scarcity [3]. Specialists in this area, consider that the developing of environmental policies and engineering support are good methods to contribute to save water. With water scarcity, decrease the productivity of food vegetables, legumes, fruits, wheat, corn and food for animals that produce food the people, increasing the costs of its products, generating economic problems [4]. According to a report of the Comisión Nacional del Agua in Mexico (CNA), in this region, water decreased, and declined in UA and wells in the last 20 years and about of 12,000 hectares was damaged and is infertile zones to agricultural activities and to be used for people. Water of this All American Canal comes from the northern of United States, in Wyoming, and is a source to SLRC and Mexicali

cities and valleys. This has been reducing the commercial and industrial operations in the last five years.

1.1 Water for life. Water is the key to the survival of life, and is essential for the viability and development of any civilization, in order to respond to the requirements and basic needs of communities. Some difficulties have been analyzed and proposed solutions for the provision of water to small and large populations to agricultural and industrial activities [5]. In the last 30 years water has been scarce and is not enough to supply to people. A whole range of actions has been important factors to avoid the damage in sources of water used in human activities [6].

1.2 Ecological use of water. Is very important approach the water resource adequacy, involving to public and private institutions and the people. Is very significant that government agencies, universities and public and private institutions know about it problem, and make new activities to present and future periods to ensure the sources of water [7]. Is necessary protect our environment to ensure to the present and future generations the sufficient food and water, that are the most important tasks to any society [8].

1.3 Domestic consumption. Many houses in developed countries consume already of 1500 liters of water at week [9]. At the same time more than 1,700 million people not have access to this water. The WHO considers an ideal consumption of 100 liters per day [2]. Two thirds of Mexico have water shortages, while in other zones exist excessive use of this resource [4]. This unequal distribution, generate serious environmental problems, originating climate change and economic and social lack of balance.

1.4 Irrigation programs. With low productivity of water, the negative effects are the salinization, desertification and erosion [6]. This result in infertile soils that immediately leads to food shortages that are a serious problematic situation in the world with a population, that growth very fast around 90 million people per year. According to the Food Agricultural Organization (FAO) since 1950, the water consumption increase at three times in the world. While the consumption was increased in 50% in the last 50 years, the sources have less levels of water. In the agricultural activities water is used at 70%, in industrial plants at 20% and only 10% to people. Today, a quarter of the world's countries have insufficient water in both cases: quantity and quality, by the inappropriate use, increasing the risks of health in the population, principally of stomach and respiratory infections [9]. Some studies estimate that 80% of all illnesses and 33% of deaths in developing countries are related to the inadequate quality water. According to the United Nations (UN) mentioned in a study called "four of five endemic diseases in developing countries are caused by dirty water or lack of health facilities", health of people is down every day. The WHO reported that water scarcity is responsible for three quarters of the 49 million of deaths that occur on the world each year, and 2500 world half-million people suffer from diseases associated with water

pollution and lack of hygiene, indicating a strong correlation between the failure and quality of the resource and the occurrence of diseases [3].

1.5 Water scarcity and global economy. Simultaneously with the environmental degradation, the economic conditions of the population in most developing countries have stagnated or decayed with the reduction of water [8]. While in the 60's, water was enough to cities and towns, at the beginning of 21st century, populations were immigrated to new regions by water scarcity. This produces problems in the economy and social factors. At this time, developed countries, with 20% of world population, poor countries have the 80% of population that around 60% have water shortages. Currently, more than one billion people live below the poverty line, with a dollar a day [10]. The reconfiguration process involves a strong economy and continued polarization in the distribution of water to have good life and avoid economic problems. Will it be possible to have life of high quality and can control the natural resources of this world?

2. Methodology

The method used in this study was an examination of use of water in the cities mentioned above and propose the use of ACS to save water, to be used in agricultural, industrial, commercial and domestic activities. The analysis has four steps:

- a). Sonora-Baja California analysis in the use of water. According to the CNA, principally in San Luis, Sonora and Mexicali, Baja California, some areas of this region have an inappropriate use of water and estimates that can extend the problematic situation of lack of water in the next five years. For reason this public institution consider that is very important this study.
- b). Covering of All American Canal and the negative effects in SLRC and Mexicali. It is of great concern, knowing that the precipitation of water into the subsoil and therefore in some parts of the valley of SLRC and Mexicali will reduce the water levels and is necessary to care water and decrease the food production.
- c). Microscopic soil evaluation. Evaluation of different areas of this region, where was applied and nor used the ACS, with Scanning Electron Microscopy (SEM) in various areas of the cities evaluated.
- d). Manufacture the ACS. In some areas of SLRC and Mexicali, is estimated that about in five years, will be a reduction of up to 80% of the water sources. For this reason is important use this electronic equipment to save water, at low cost with an efficiency of 100%, tested for five years in the cities.

2.1 Proposed water conservation. In this study, there is a proposal of the use of ACS, which operates with solar energy, at low cost (around \$10 dls) and maintains the high levels of the sources of water. The first step involved an

analysis of polluted water by solid residues in the cities evaluated with values of 43% in Mexicali and 39% in SLRC. The second step was developed to manufacture an ACS and the third step to probe the operation of the ACS.

2.2. Analysis in domestic activities. The ACS was probed in domestic activities with an efficiency of 100% in the five years of the study. There were some tests to develop with the 100% of efficiency of ACS (Figure 1), such as:

- Evaluation of water consumption in agricultural, commercial, domestic and industrial activities.
- Use a methodology for developing the ACS to promote the environmental awareness.
- Analysis of electronic devices with an efficient design at low cost.
- Proposal to be applied in domestic and educational activities to experimental testings.

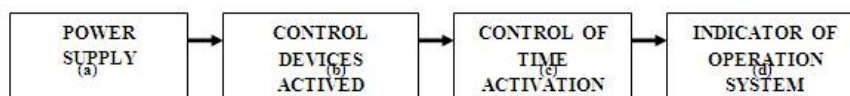


Fig 1. Steps of operation of the ACS to save water, probed in Mexicali



Fig 2. ACS equipment used in Mexicali

The ACS for water saving consists of four parts that generate the process of the operation: (a) with a power supply that generates the necessary energy to activate (b) the electronic devices (Integrated Circuits, IC) and activated, according to a timer device with the (c) electronic components to control the operation, and generated by electrical actuators. Automatic IC timer programmed is good to use to this activity, but is very expensive and not easy to program, only by specialists. Finally we have the signal indicators on and off, controlled by a device that identifies the periods in which automated equipment is activated and not activated. With this automatic system ensures a savings of approximately 80% of water in

domestic, commercial, industrial, agricultural activities in the cities mentioned above from 2007 to 2011. The power supply is of 12 volts of direct current to provide the electrical energy to turn on the electronic system. The control devices to active and turn off is with electronic components used in the electronic sensors and the process to maintain operating the electronic system depends of a value of electronic resistor, being represented by a luminescent indicator to indicate when is turn-on and turnoff the ACS.

3. Results

The ACS contributed to saving water for five years in the Sonora-Baja California region. This prevents water shortages, as they are proven to perform an ecological awareness in the society of this zone of Mexico. Table 1 shows percentages of efficiency of use or not of ACS from 2000 to 2009 in Mexicali and SLRC, indicating the necessity of use the ACS that probed a saving process of water at 55% exactly. The water saving percentage was 45% in San Luis Rio Colorado with a population of 350,000 and Mexicali with 1,000, 000 was 55% [11]. These populations required the use of ACS, which decreased by use of water in order of average of 50%. Water supply varies depending on the activities in each city in this arid region, where the consumption was evaluated in domestic activities, increase the water saving. Table 2 represents the use of water in industrial activities, where the consumption was high. Table 3 indicates the use of water in agricultural operations, that is the second activity that consume a lot quantities of water, less than industrial and more than commercial and domestic areas. The cities of SLRC and Mexicali were the cities where people have inadequate use of water. Water consumption is a bit higher than diagnosed by WHO for use right, which is 1000 m³ per week on average for each person. The values were obtained by a process of study and statistical estimation in the five cities evaluated, and 50 colonies in each city, with data from 2007 to 2011.

3.1 Numerical analysis

This analysis was made to know the relation between the environmental concretization and the use of water (liters / week by person) in each city. In the both cities evaluated the water consumption, can be observed the increase of water principally in the summer season, being Mexicali the city with more use of hydraulic resources every day, more than in SLRC. The analysis was made in house of citizens of both cities.

Figure 3 shows at 73% of relative humidity (RH) and 42 °C of temperature with 3489 liters every three days by house water consumption, being the higher water consumption in SLRC in summer (in July and August) of 2011 used to watering plants, wash cars, use in a domestic activities (in the kitchen, wash clothes and in the bath).The less level was 3510 liters every three days at RH of 40% and temperature of 10 °C. The color marked, represents the levels of levels of awareness of water conservation measured by the consumption of water and the

grade of levels of schooling to stand that at high grade of school, better awareness on water conservation, but it's not was really, principally in Mexicali people consume more than in SLRC. The red color indicates low awareness on water conservation and green-blue the good awareness. Figure 4 indicates that at 68% of RH and 26 °C, with a water consumption of 956 liters every three days by house in winter (December and January). The less level was 425 liters every three days, at 38% of RH and 7 °C of temperature. As represents the color, the level of awareness not was very several.

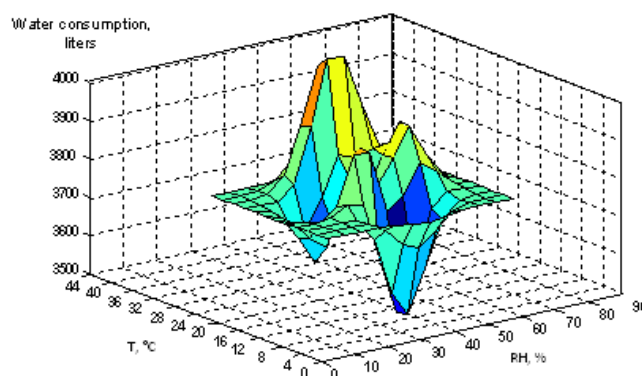


Fig 3. Correlation of use of water by houses in SLRC in summer in 2011.

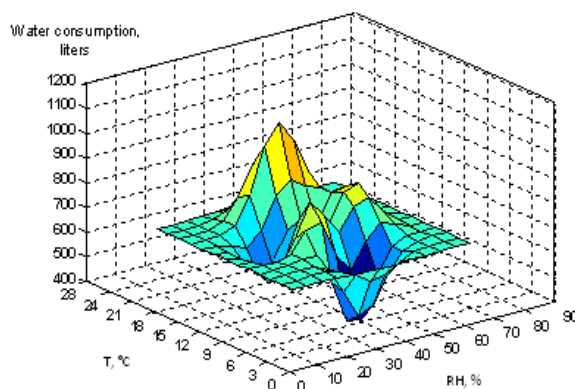


Fig 4. Correlation of use of water by houses in SLRC in winter in 2011.

Figures 5 and 6 represents the water consumption evaluated in Mexicali indicated that in this city the awareness is less that in SLRC. Some people was studying for several year this topic, but not are persons who make any control, principally by ACS, as show this research. Figure 5, shows value of water consumption of 3879 liters every three days at 70% of RH and 42 °C in summer. The less intensity was 3356 liters every three days at 74% of RH and 26 °C of

temperature. In this figure the level of awareness was very low indicated by red color.

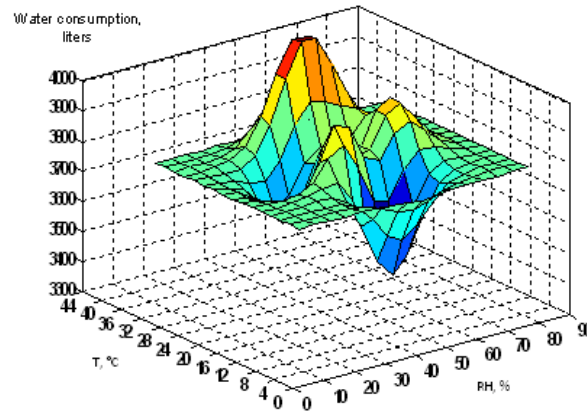


Fig 5. Correlation of use of water by houses in Mexicali in summer in 2011.

Figure 6 shows the same correlation of the parameters mentioned above indicating the high level of water consumption of 1306 liters every three days by house and the less intensity was 714 liters every three days by house at 67% of RH and 20 C of temperature. In each house evaluated live around four persons. This figure represents the color red as the lowest level of awareness of save water in domestic activities.

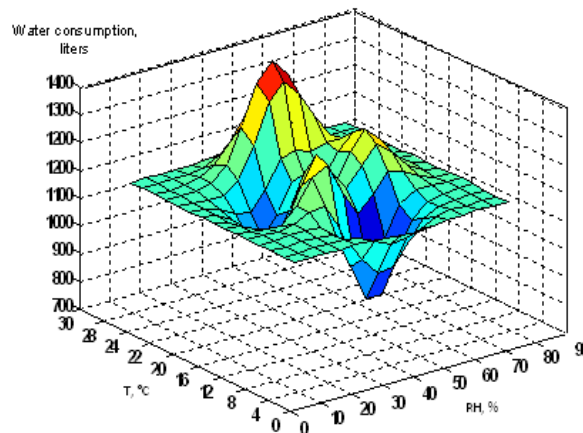


Fig 6. Correlation of use of water by houses in Mexicali in winter in 2011.

3.2 SEM evaluation. The advantage to use the ACS for saving water allowed having more fertile soils in agricultural, green areas in industrial, commercial and domestic zones and reduces at low percentage the high temperatures in summer. We can see that when not use the ACS, can damage the soil cracking (Figure7),

and change with the use of ACS observed in the figure 8, that remains wet the soil and this require less water to irrigate.

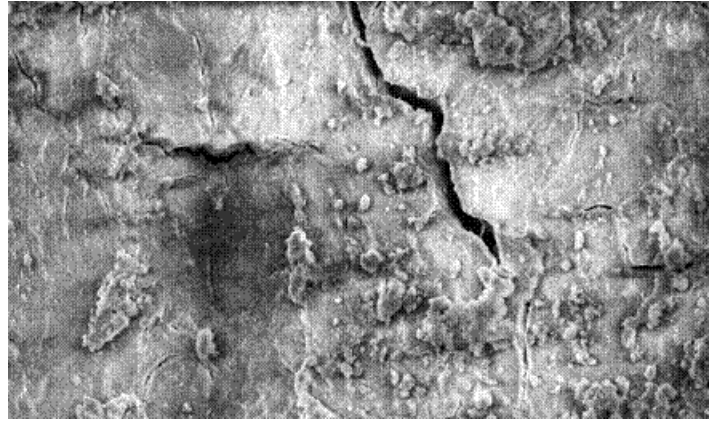


Fig 7. Microphotography (100µm) of soil before use the ACS

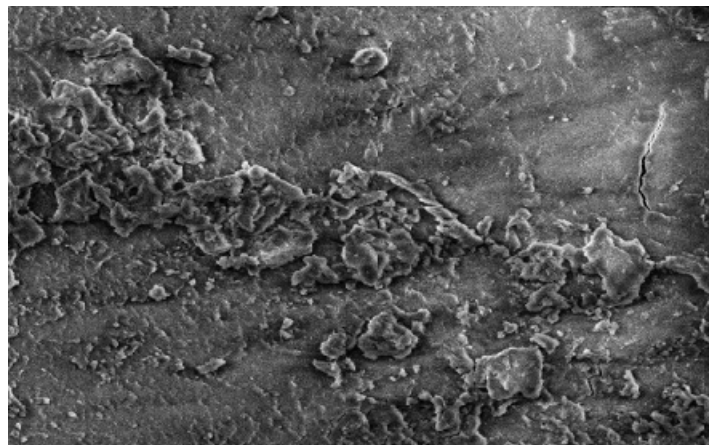


Fig 8. Microphotography (100µm) of soil after six months using the ACS.

4 Conclusions

The water saving systems are very important in the care of water. It must be realized in the use of water because it is a nonrenewable resource, and in certain regions of the world have the problem of water scarcity. It begins to have serious social problems, and could be a possible cause of a war between countries, by the vital fluid. The water in Mexicali is consumed with a great lack of awareness, in some activities such as irrigation in fertile zones and green areas. There were two important reasons to develop this study: In this zone of Mexico is necessary have good awareness to save water, otherwise water will be decrease their level and will be more expensive and all products and operations to need water. We propose some improvements to save water:

- Create an environmental assessment in the use of water, in cities evaluated and principally in SLRC and Mexicali, where will be problems in the next years for the covering of the All American Canal.
- The design and the cost of ACS is very accessible.

5 References

1. Arévalo Germán; Conciencia en el uso del recurso hidráulico del siglo XXI; Editorial Trillas, 2000.
2. World Health Organization, WHO; Use of water in the World, 2004.
3. Romero A. & González R.. Efectos del revestimiento del Canal All American en los valles de San Luis y Mexicali, XX, 2005.
4. Sánchez P., Páez A. & Flores R., Evaluación zonas de cultivo sustentables y el uso adecuado del agua, Editorial Panamericana, 2006.
5. Rueda S. & Domínguez B., Niveles de concientización del uso adecuado del agua, Editorial Trillas, 2002.
6. Beltrán H. & Leyva C., Deterioro del suelo por el mal uso del agua, Editorial Oceánica, 2001.
7. Herrera Martín & Sánchez Raúl; Uso de la electrónica con sistemas solares para el cuidado del agua y medio ambiente; Editorial Panamericana; 1998.
8. Soriano Gonzalo, Torres Armando & Zamudio Joaquín; Aspectos para el cuidado del uso del agua y la economía de cada región mundial; Editorial McGraw-Hill; 1996.
9. Zarate Oscar; Uso básico de dispositivos electrónicos en la industria; Editorial Oceánica; 2000.
10. La economía y el desarrollo sustentable, Editorial Oceánica.