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Overview of Drinking Water Procurement and Processing in Plant No.1 (Hesar Branch) Karaj City-Iran

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Abstract: **The water is a simple chemical compound, but with complex properties because of its bias. The chemical formula of water is H_2O. That is, each water molecule consists of one oxygen atom between two hydrogen atoms. Water is essential for human health and well-being; there can be no life on Earth without water. Specifically in Iran country, freshwater availability is too scarce and it is necessary to provide clean drinking water to all citizens. In the Karaj city drinking water is one the main issues and challenges of the government, due to the decrease in the quality of raw water because of environmental and ecological changes, disposal of solid wastes and wastewaters, and also increase in the population and per capita consumption of drinking water, uncontrolled usage of drinking water as result of lack of appropriate consumption patterns of water and drought seasons, are just a few examples of the major challenges of drinking water faced by people and the government. So it is very important to know and to understand different technologies that have been adopted for drinking water to ensure health and safety of the citizens. This study talks about the overview of drinking water procurement, processing in Karaj city-Iran.**

Keywords: **drinking water, procurement, processing, Karaj city-Iran.**

I. INTRODUCTION

We know that Water is all and in fact the very origin of all living beings as it is next only to Air for survival of not only humankind but all Animals and plant kingdom on this good earth. Water Covered with almost 3/4th of the earth planet. But we are also aware that what Samuel Coleridge meant in saying "WATER, WATER EVERYWHERE BUT NO DROP TO DRINK" in his famous Rime- "the Ancient Marriner".

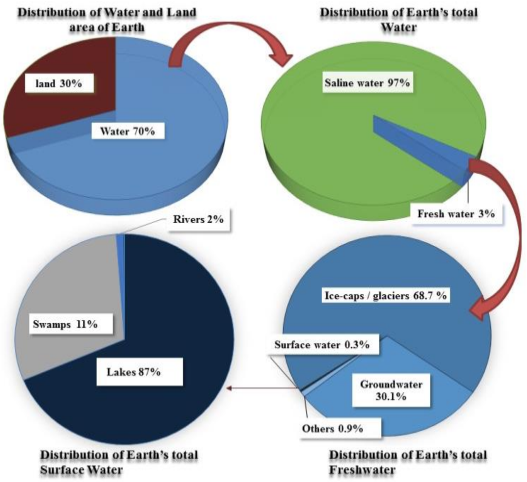

Fig. 1. Distribution of Earth water

It is evident from the figure 1 (Distribution of earth's water) that:

- Out of Total available water on, above and under the earth, > 97 % is stored in Oceans and Seas But this water is neither potable nor usable for agriculture, Industry or any other domestic purpose as it consisting > 35 % dissolved salts mainly common salt, NaCl.

- In Contrary, only 3 % of Total global water is available as FRESH WATER which only support all needs of human beings, animals, agriculture, Industry and tall other requirements. But it is seen that out of total Fresh water, > 68% is locked in Ice-caps / glaciers, 30% is hidden in Underground and only 0.3 % is available on surface in the form of Rivers, Lakes swamps etc.

Nearly 1 billion people go without clean water every day. Yet access to clean, fresh drinking water is a major world concern [1]. Freshwater is of major importance to all living things; in some organisms, up to 90 percent of their body weight comes from water. Up to 60 percent of the human body is water, the brain is composed of 70 percent water, and the lungs are nearly 90 percent water. About 83 percent of our blood is water, which helps digest our food, transport waste, and control body temperature. Each day humans must replace 2.4 litters of water, some through drinking and the rest taken by the body from the foods eaten. A common definition of clean water is water that is free of pathogenic organisms, toxic substances, colour, turbidity, taste, and odour, and an acceptable level of minerals and organic material [2]. There should always be a strive to use the purest sources of water for domestic purposes, even if it is at the cost of transferring water from long distances to deliver it to the consumer or just with a little treatment. Also taking care of water resources is essential to protect water quality. However, all natural sources of water to meet the standards for drinking water are usually in need of treatment. Processes that are used for drinking water purification, depends on the water quality of used sources. Normally groundwater is clear and free of pathogens and also does not have significant amounts of contaminants. Such water can be used in drinking water systems by adding the least amount of chlorine to prevent contamination of the distribution network. But this underground water may contain large amounts of dissolved solids, gases, or excessive amounts of iron, manganese, or even organic substances and microbial, In which case it requires complex treatment process. Surface water often has a greater variety of contaminants compared to groundwater and therefore refining process would be more complex for such waters. Most surface water has exceeded turbidity as specified by the drinking water standards, although the water flowing too fast may contain large suspended materials. But most of these solids are in colloidal size and treatment processes is required to separate them. Water purification process that is commonly used is:

1. Inlet Structures
2. Raw water chlorination
3. Chemical injection and rapid mixing
4. Sedimentation
5. Clarification (Pulsator)
6. Water filtration
7. Disinfection and adjustment of residual chlorine
8. Dewatering and drying the sludge and excess water disposal

II. MATERIALS AND METHODS

A. DESCRIPTION OF THE STUDY SITE:

Iran Located in one of the most arid regions in the world, while one percent of the world population lives in Iran The main source of water is precipitation, which normally amounts to 251 mm or 413 billion cubic meters (bcm) annually. This precipitation depth is less than one-third of worldwide average precipitation (831mm) and about one-third of the average precipitation in Asia (732mm). The total water withdrawal was estimated at about 70 bcm in 1993, rising to 93 bcm in 2004, of which 92% was used for agricultural purposes, 6% for domestic use and 2% for industrial use [3].

Alborz Province is one of the 31 provinces of Iran, centered in Karaj. Its population was 1.96 million in the latest 2011 census, making it the fourth-largest city in Iran. Alborz province, located at the West of Tehran province in Iran, Due to being located near the capital city, this province attracts many immigrants and it enjoys particular political, economic, cultural, and commercial situation. Based on the forecasts, this province, as many other provinces in Iran will face water shortage in the coming years and if the present trend of consumption continues [4]. Karaj's climate is a bit cooler than Tehran and it receives 260 mm of rain annually. Köppen-Geiger climate classification system classifies Karaj climate as cold semi-arid. Natural water Resources of Alborz Province are divided into two categories:

- **Surface water:** the northern highlands permanent rivers originate in Alborz Province including Karaj, Taleghan and the Kurds. River Branch: Branch is the central part of the Alborz Mountains (Kharsang Mountain) comes from the route after receiving several subsidiaries including Varangehrud, the province, and Shahrestanak Azadbar bed meander to the south of the province Alborz flows and finally flows into the Salt Lake Qom. Karaj Amirkabir dam or barrier type double-arch concrete dam, following the height of 18 m, crest length of 39 meters, built on the 1342 and tank volume is 25 million cubic meters.

- **Groundwater Alborz Province:** low rainfall, seasonality and increasing need for Water Rivers in southern Alborz Province has caused more water to agricultural, industrial and drinking water supply is groundwater.

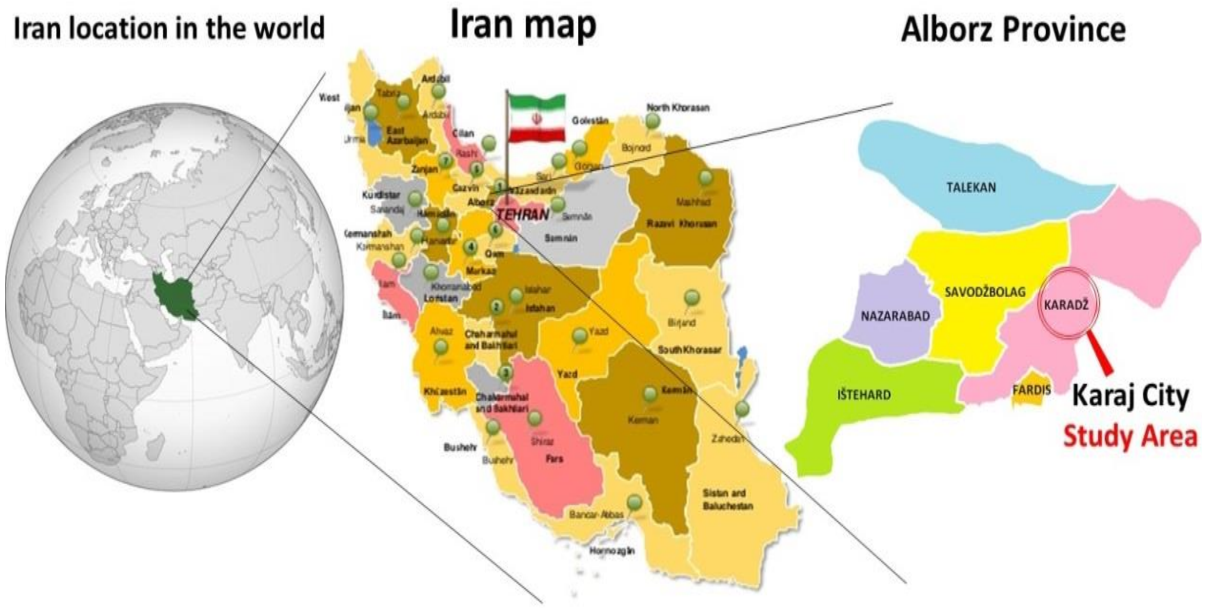

Fig. 2.Location of Karaj city-Iran

Water Treatment Plant No.1 Hesar Branch has been designed and launched to supply drinking water to the cities of Karaj and Islamabad. This plant situated on Hesar line 3 and is located at an elevation of 1320 meters above sea level. Phase 1 of this plant has a nominal capacity of 0.83/0 cubic meters per second and maximum capacity utilization is equal to 1/0 cubic meters, Phase 2 of this plant has a nominal capacity of 166/0 cubic meters per second and maximum capacity utilization is equal to 2/0 cubic meters. The raw water entering to this plant comes from the Karaj dam which connects a 3 Km Steel and concrete pipe line by gravity method through the plant from the Bileghan pond.

B. DESCRIPTION OF DRINKING WATER TREATMENT PLANT NO.1 (HESAR BRANCH) – OVERVIEW:

The principal aim of every conventional drinking water treatment plant should be to provide accordingly sensitive standards of service, to gain customer satisfaction, delivering to consumer's water that is both aesthetically pleasing and to meet public health safety requirements [5].

The drinking water treatment plant No.1 in Karaj city consist of Physico-chemical and microbiological process where the raw water turbidity and microbial load is reduced to the desired standard level and also the reduction of some minerals and chemicals are done. The process of water treatment plant consists of the following steps:

- **Screening:** the raw water is initially screened through a set of coarse screens to remove gross solids, such as litter and branches, before being conveyed to the plant.

- **Preliminary chlorination:** the main purpose of Chlorination in the raw water where the water entering to the plant is to partially eliminate the organic pollutants causing undesirable odor and taste, Partial removal of inorganic contaminants producing colour such as Iron, manganese, heavy metals And sedimentation in the clarification stage and also to prevent further growth of micro-organisms and other water plants in the water treatment plant system.

- **Preparation and chemical injection:** at this stage Ferric Chloride is used as coagulant agent and stored in 4 reservoirs with the capacity of 10 cubic meters, Prepared by Dissolution tank and injected to raw water channel through transmission lines. Lime is used to adjust the pH and improve the coagulation process.

Fig. 3. The view of chemical preparation and injection unit

- **Primary sedimentation:** at this stage if the turbidity of the water exceeds a certain limit (Nephelometric Turbidity Unit (NTU) 5.2) it gets reduced to the desired level. This plant has a preliminary sedimentation pool of size 25x6x6 meters. There is a mechanical sweeping broom at the bottom of the pool which works with two speeds (low and high) to collect and discharge the settled sludge.

Fig. 4. The view of preliminary sedimentation pool

- **Secondary sedimentation (Clarification):** this plant has four Superpulsator Clarifier pool with the dimensions of 9**x**6**x**6 meters. Each one of these pools has four pumps (pump creates a vacuum in the chamber) and a Sludge discharge funnel. This step is also known as the secondary sedimentation where coagulation, flocculation and sedimentation process is done in this step.

- **Filtration:** Water filtration process is done by eight rapid gravity sand filters with dimensions of 6x5.2 meters. Effective sizes of sand grains used in the filters are 4.0 mm and the thickness of the sand layer is about 100 cm**.**

Fig. 5. The view of filtration hall and sand filter bed

- **Final Chlorination:** Final chlorination is done to disinfect and free residual chlorine in the water supply system.

- **Storage:** in the Karaj water treatment plant No.1 the finished drinking water would be stored in three tanks before it is transferred to the storage tank in the city, and the detail of these tanks are as follows:

➢ A 640 cubic meter storage tank at the refinery.

➢ Two 12,800 cubic meter storage tank at the refinery.

➢ Three 6400 cubic meter storage tank at the refinery.

Fig. 6. The view of surface water reservoir

C. RESULTS:

Water quality is the physical, biological and chemical characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and/or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be evaluated. The most common standards used to assess water quality relate to safety of human contact, drinking water, and for the health of ecosystems [6-10]. Raw water is treated to obtain treated water which conforms to national drinking water standard. Table 1 presents the nine of the essential parameters which should be tested frequently.

TABLE I: Essential parameters to assess water quality

PARAMETERS	UNIT	SPECIFICATION	FREQUENCY
pH	-	6.5 – 9.0	2 HOURLY
COLOUR	TCU	15 (max)	2 HOURLY
TURBIDITY	NTU	5 (max)	2 HOURLY
RESIDUAL CHLORINE	ppm	3 – 3.5	2 HOURLY
RESIDUAL FLUORIDE	ppm	0.4 – 0.6	2 HOURLY
ALUMINIUM	ppm	0.2 (max)	8 HOURLY
IRON	ppm	0.3 (max)	DAILY
MANGANESE	ppm	0.1 (max)	DAILY
TOTAL COLIFORM	CFU/100ml	NIL	DAILY
FEACAL COLIFORM	CFU/100ml	NIL	DAILY

III. CONCLUSION

As we know water is very essential for our existence, the growing population and industrialized Karaj city increase the rate of water polluting by many ways. These actions lead the water to be contaminated and non-consumable as it causes many diseases and health issues for human life. Around 70-80% of diseases are caused by impure water only. This life-threatening problem makes us to follow the water treatment action to fight back. Water purification is the best and recommended action of water treatment action which provides us safe, clean and pure water. Water purification in Karaj is an important treatment that is carried out by the government for the following reasons:

- Through water purification we can avoid drinking impure and contaminated water which cause many epidemic diseases and is unsafe for healthy life.
- It removes all unnecessary bacteria and viruses from the water which are hazardous to health. it is purified or filtered by advanced technology to eliminate all bacterial disease that may cause death.
- It also helps in purging the unwanted chemicals and toxins from the water which might be added by factory and mines wastes. There are many chemicals which produce alpha radiation that leads to cancer and many skin or digestive tract irritation.
- This water treatment facility in Karaj helps in removing the heavy metals like mercury, arsenic leach or lead from water which are very difficult to detect and can cause long-term neurological impairments.
- The filtration not only removes the toxins and make the water clean and pure but also improves the taste and appearance. To make the water drinkable and consumable with no unpleasant odor; the water purification plays the vital role in doing so.
- Having pure water is becoming integrated part of life. Mineral water bottles are not affordable enough for everyone at regular intervals; so here water purification is the best viable way to use direct tap water. It saves the money.

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