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Waste management options to control greenhouse gas emissions – Landfill, compost or incineration?

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***Abstract*—**Methane (CH_4) is predicted to cause as much global warming as carbon dioxide (CO_2) over the next 20 years. Traditionally the global warming potential (GWP) of methane has been measured over 100 years. The IPCC's Fourth Assessment Report (IPCC 2007) warns that this underestimates its immediate impact. Viewed over 20 years it has 72 times the GWP of CO2.

The current study was prompted by concern about these emissions, and by a recent Government policy study in Melbourne, Australia, which recommended composting of municipal waste. The mass composting of waste would reduce landfill gas, currently used as a fuel. This study uses recent information (2006 IPCC Guidelines) with local data to estimate:

- How much greenhouse gas is emitted to the atmosphere from best practice landfill with methane capture Pipes? How much can be captured to use as fuel?

- Is aerobic composting or incineration better at controlling emissions than landfill with gas capture?

***Keywords*—**Landfill, incineration, GHG emission, correction factor, bio-fuel.

I. Introduction

In Melbourne, metropolitan waste management and Resource Recovery Strategy (MWMS 2008) examined several options for solid waste management in 2008 and produced a policy this year. Melbourne households are already supplied with two bins, one for recyclables (bottles, cans, plastics, paper) and another for residual waste. Suburban households often have a third bin for garden waste. Australia has a policy of minimizing waste to landfill. A study of residual waste in 2005-6 found that 41% was food waste, 18% green waste and 6% paper – all organic waste which could be composted. The MWMS plan considered options for diverting organic waste from landfill, including composting residual waste in large-scale Advanced Waste Treatment composters (AWTs); separating organic waste for aerobic or anaerobic composting, and thermal power from waste. Hyder Consultants (Hyder 2008) were employed to carry out a study. They found thermal electricity generation performed best in all areas, even reducing air pollution because it would replace highly polluting brown-coal-fired energy, which is the current source of Melbourne's electricity. Burning the waste would also reduce GHG emissions by eliminating methane from landfill. However it rejected the option of incineration because of community concerns and difficulty in siting the incinerators.

II. Methodology

A spreadsheet was set up to compare emissions of methane, nitrous oxide and anthropogenic (man-made) carbon dioxide from compost, landfill and incineration, based on IPCC figures. The IPCC model allows for differences in temperature, humidity, dryness and aeration in the landfill, and different types of organic waste.

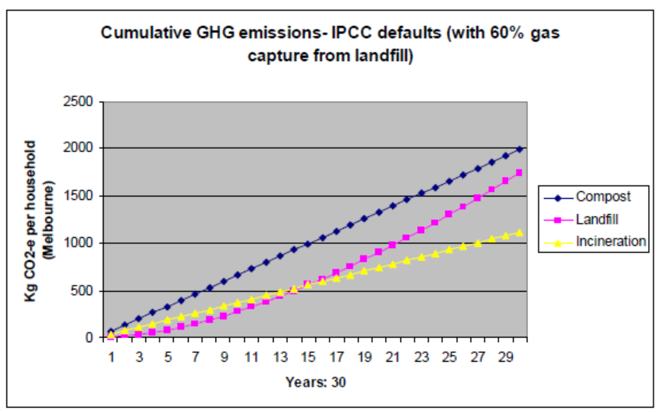

Fig. 1 Greenhouse gas emissions over 30 years: compost, landfill and incineration

Over the next 30 years, incineration produced the least greenhouse gas emissions, followed by landfill with gas extraction. Surprisingly, aerobic composting produced the highest level of emissions. This is based on the assumption that landfill has leachate and gas capture pipes, as is now common in Melbourne, with 60% gas capture. We assumed

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that 10% of the escaping methane was oxidized as it passed through the soil cover, and some waste would break down aerobically before anaerobic conditions were established. IPCC estimates for CH_4, N_2O and anthropogenic CO_2 emissions from composting and semi-continuous fluidized bed incineration were compared with the landfill emissions.

A. Measuring methane from landfill, composting and incineration

Our present study aims to objectively compare the options for waste disposal. It uses the United Nations Framework Convention on Climate Change (UNFCCC/CCNUCC) "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", version 4, 2008 ("the tool") to compare methane generation from landfill versus aerobic composting and GHG emissions from incineration. Equations and background information from the 2006 IPCC "Guidelines for National Greenhouse Gas Emissions", Vol. 5 "Waste", Chapters 2 – 5 and Vol.2, "Energy" were also used. The following factors are used to calculate methane emissions:

1. Quantity of organic waste deposited in landfill each year, per household.
2. Fraction of degradable organic carbon in the waste (averaged over its various components)
3. Fraction that actually converts to methane. Only about half of this matter ever decomposes, and of this, only half converts to methane.
4. The conversion factor from carbon to methane.
5. The rate of accumulation of waste in the landfill, and the rate of decomposition of waste.
6. Methane captured from landfill for flaring or fuel.
7. "Methane correction factor": Some organic material decomposes aerobically due to oxygen inside the landfill: less if it is wet and anaerobic, more if it is well managed and dry.
8. Some methane oxidizes on its way out, if the site has a soil or compost "bio cap" cover.

Altogether, only a very small amount of potential methane escapes from best practice landfill, and it is produced very slowly, as the decomposition rate in a dry temperate climate is only about 5% per year. Aerobic composting produces mostly CO_2, but also releases a small amount of methane (the IPCC default estimate is 4 grams of methane per kilogram of organic waste). Incineration produces mostly CO_2. Open burning of waste does produce CH_4 but continuous fluidized bed incineration produces none at all. In this study it is assumed that semi-continuous fluidized bed incineration is used – this produces CH_4 and N_2O which have been taken into account in calculating emissions.

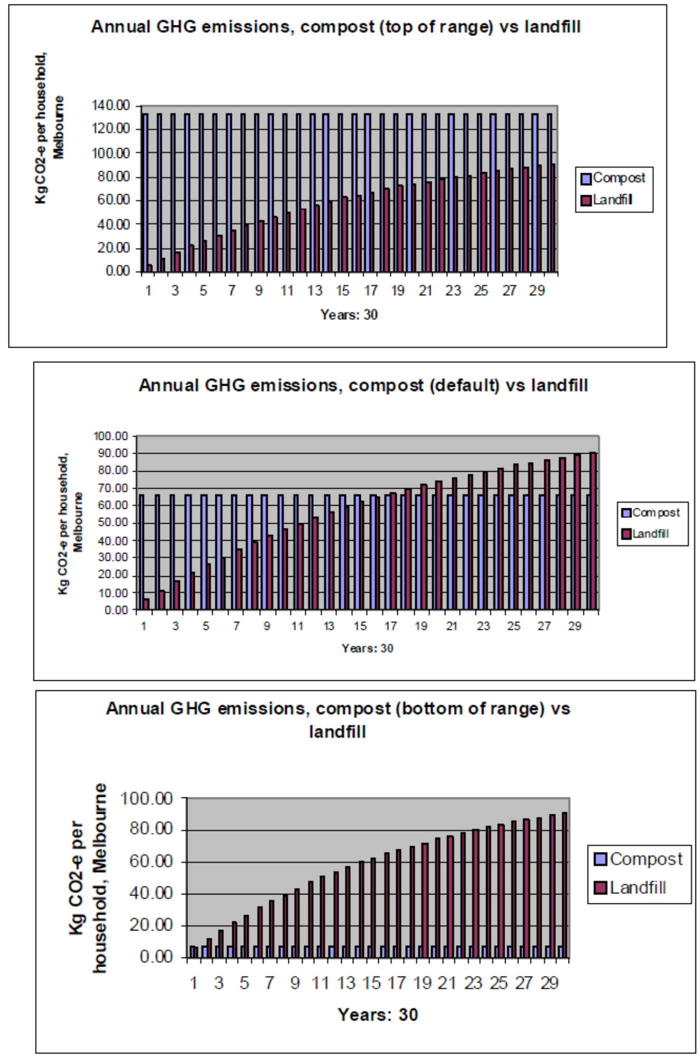

Fig. 2 Greenhouse gas emissions over 30 years: landfill compared to a range of values for composting.

The top chart shows maximum expected GHG emissions for managed composting. These are likely to be found in a warm climate, where compost is kept wet. The second chart shows the IPCC default value for compost. The third shows minimum values, probably inapplicable to Australia. Much of the IPCC's referenced data is from Scandinavia and Finland where it is very much colder than Australia and so little methane is produced. Methane and N2O emissions from poorly managed composting may be even higher than those shown in the top graph. Bert Metz (2007 IPCC) points out "CH4 and N2O can both be formed during composting by poor management and the initiation of semi-aerobic (N_2O) or aerobic (CH_4) conditions; recent studies also indicate production of CH_4 and N2O in well-managed systems (Hobson et al 2005)."

A small but disturbing study from the Griffith University, Queensland, Australia (the Insinkerator study, 1994) compared household composting systems with sink disposal units and landfill. Very high levels of methane were found in

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unmanaged household compost bins.

B. Assumptions on methane correction factor in landfill

The above graphs assume a methane correction factor (MCF) of 0.6 for landfill, i.e. it is 60% anaerobic. The IPCC recommends this value if it is not known how the waste is managed. If waste is unmanaged in a shallow tip, the MCF value is 0.4, as much of the waste will degrade aerobically. If the waste is buried deep or the water table is a high, e.g. if it is dumped in a swampy area, a value of 0.8 is used. If it just compacted or levelled and covered, the MCF is 1.

In the 1996 IPCC Guidelines, all managed waste was assumed to be 100% anaerobic (an MCF of 1). This was a heroic assumption. It requires only very low levels of oxygen in the waste to produce some aerobic decomposition, especially before anaerobic conditions are established in the waste (see Metz, IPCC 2007). A recent Swedish study (Smars, Sven and Beck-Friis 2002) found some aerobic decomposition in waste was still occurring at 1% oxygen levels. In the 2006 IPCC guidelines a new category of semi-anaerobic landfill has been introduced with an MCF of 0.5. This type of landfill has leachate drainage, gas capture, ventilation and permeable cover. In Melbourne, landfill sites typically have leachate drainage and gas capture. It is uncertain whether the tip cover is permeable. (It is not intended to be, yet it is estimated that 40% of the methane escapes through it.) The subsoil is extremely dry, relative to Europe and Scandinavia. This would tend to allow oxygen to penetrate. Further studies are required to establish how much decomposition occurs before landfill conditions become anaerobic, how much oxygen is found in landfill gas and what the real MCF is in Melbourne. The Australian Government Department of Climate change still classifies all landfill in Australia as 100% anaerobic on the grounds that it is "managed". This follows the classification in the now superseded 1996 IPCC Guidelines. More up-to-date estimates are needed.

C. Why do the results show higher emissions for compost relative to landfill and incineration than are generally assumed?

Much of the widespread understanding of GHG emissions from landfill, compost and incineration is based on early modelling in the 1996 IPCC Guidelines. Since then it has been discovered that:

- composting does release CH_4 and N_2O. A range of estimates has been provided.

- Landfill is not always 100% anaerobic but can be semi-anaerobic, with an MCF of 0.5.

- Much organic material in waste does not degrade under anaerobic conditions. The 2006 IPCC advises that only 50% at most will decompose in landfill. Of this, only about 5% of decomposable organic waste decomposes each year.

- A "First Order Decay model" has been introduced to account for the slow decay of waste in landfill: Earlier models erroneously assumed that decomposition all occurred in the first year.

III. CONCLUSION

An earlier, more detailed study of the options for Melbourne's municipal waste, suggests that the goal of diverting waste from landfill is over-emphasized as Melbourne has adequate landfill space, and more is created by quarrying activities. The huge volume of poor compost produced if all household waste is composted may lead to a collapse in the market for compost.

- Well managed landfill with gas capture can reduce methane levels and delay emissions for decades. About 50% of the organic carbon is sequestrated and only about 5% of waste decomposes in landfill annually. Most of the methane can be captured or oxidized at the landfill site.
- there is great potential for energy generation from thermal electricity generation from municipal waste; from landfill gas and in some cases anaerobic digestion of separated waste. Spark ignition motors are currently used to convert methane to electricity, but fuel cells, cogeneration of energy and heat, and direct use of methane are all possible.
- Municipal waste should not be routinely composted before disposal, and certainly not in open air windrows. Landfill with gas capture is a better option for reducing emissions, and producing bio-fuel.
- Home composting bins may produce more greenhouse gas per unit of waste than landfill.
- Compost can play an important role in Australia, especially in organic farming and as tip cover, to oxidize escaping methane, but high quality compost from separated organics is best for both purposes. The priority is to compost rural and animal wastes which currently do not go to best practice landfill and may be releasing large quantities of CH_4 and N_2O.

REFERENCES

[1] IPCC 2007: Fourth Assessment Report, chapter 2 pp 206, 212 Diagram 22.25 and text.
[2] MWMS 2008: "Draft Metropolitan Waste and Recovery Strategic Plan" released on 2 April 2008 at
[3] www.sustainability.vic.gov.au , now accepted with some changes. Most information is in the "Schedule".
[4] 2006 IPCC Guidelines for National Greenhouse Gas Emissions Vol. 5 "Waste", Chapter 2-5 and Vol. 2, "Energy", section 2.3 Table 2.4.
[5] UNFCCC/CCNUCC "Tool to determine methane emissions avoided from disposal of waste at a solid waster disposal site" (version 4, 2008).
[6] R. Pipatti and I. Savolainen 1996, "Role of Energy Production in the Control of Greenhouse Gas from Waste Management,"

ISSN (Online): 2305-0225
Issue 16(4), September 2014, pp. 499-502

[7] Hyder Consulting (2007): “Modelling and analysis of options for the Metropolitan Waste and Resource Recovery Strategic Plan,” 2007.
[8] Lifecycle calculations by Tim Grant are in the “Appendix: LCA of Waste Management Options”, RMIT Centre for Design, Dec 2007, on www.mwmg.vic.gov.au
[9] Boral 2007: Comments from Boral in response to reference 3 above, from Boral Melbourne, www.boral.com.au, or at: www.sustainability.vic.gov.au/resources/documents/boral.pdf
[10] Fulhage, Charles et al, 1993. “Generating Methane” University of Missouri Extension,
[11] Insinkerator Study 1994: Professor Philip Jones et al: “Economic and environmental impacts of disposal of kitchen organic wastes using traditional landfill - Food waste disposer - Home composting”, Waste Management Research Unit, School of Engineering, Griffith University, Queensland.
[12] Bateman, Sam, Hanson Landfill Services: “Response to the Productivity Commission Inquiry Draft Report on Waste Management” Feb 2006.
[13] Guzzone. Brian and Mark Schlagenhauf “ Garbage in, energy out - landfill gas opportunities for CHP projects” in Cogeneration & On-Site Power Production website //www.cospp.com. September 2007G. O. Young, “Synthetic structure of industrial plastics (Book style with paper title and editor),” in *Plastics*, 2nd ed. vol. 3, J. Peters, Ed. New York: McGraw-Hill, 1964, pp. 15–64.
[14] “Cover Up with Compost” U.S. EPA fact sheet, Washington 2002.
[15] Metz, Bert: IPCC Climate Change 2007: “Mitigation of Climate Change” Intergovernmental Panel on Climate Change, Working Group 3, Chapter 10 Waste Management.
[16] Smars, S: “Influence of different temperature and aeration regulation strategies on respiration in composting”, Doctoral Thesis, Swedish University of Agricultural Sciences, Uppsala 2002, with B. Beck-Friis.

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A Study of the Possible Solutions for Radon Concentration Reduction in Homes in Order to Minimize Energy Consumption in Ventilation Systems

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Abstract— One of the main problems engaging the attention of scientific communities is air pollution especially in indoor areas such as homes. In this regard, radon is one of the most important and dangerous pollutants since various studies and researches have shown that this gas is the second cause of lung cancer after smoking. Aiming to increase efficiency and reduce costs, current buildings have caused a lower quality of the air inside homes. Therefore, an appropriate ventilation system is required to prevent such pollution in order to provide clean and fresh air at an acceptable level. This article tries to study an optimum condition for achieving two important goals i.e. human health and energy saving optimization in ventilation systems.

Keywords— energy saving, radon, dosimetry, radon decay products, phantom

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I. INTRODUCTION

Acording to the United Nations Scientific Committee on the Effect of Atomic Radiation in 2000, the average annual human's exposure to all natural radiating sources was estimated in areas with background radiation of about 2.4 mSv and more than 52% of this radiation was due to inhaling radon gas and the rest was related to other natural radiating sources [1].

Uranium is the main source of radon. Also the concentration of radon is higher in some stones like granite, limestone and phosphate stones. The main danger caused by radon is lung cancer [2].

Researches indicate that the first cause of death from lung cancer is inhaling radon. Since our country (especially the northern region like the city of Ramsar) is one of the hottest spots in the world in terms of field radiation, we should pay special attention to this issue in order for reducing the risk of lung cancer. According to the studies, death from Drunk driving accidents is the first cause of deaths in America, and cancer from inhaling radon, drowning, fire, and plane crashes are the next ones. Radon is a radioactive gas produced by the natural decomposition of uranium in stones and soil [3]. It then reaches the surface of the Earth through the cracks and fissures in stones and is then released into the air. Radon is a colorless, odorless, tasteless, and neutral gas. As the amount of radon concentration in the environment is low, there isn't a

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serious threat to humans; however, the amount of this gas goes up in an indoor area over time and the level of radon will increase. These particles stick to the particles floating or aerosols in the air in an indoor place enter the human's respiratory system and then hurt the sensitive tissues there. Too much energy will concentrate in a small area of tissues and causes chemical ionization, the formation of DNA and damage to DNA molecules [4].

Given the dangers from this gas, some measures should be taken to reduce the level of radon in residential buildings. Using a standard ventilation system is the best way to reduce it because ventilation is the best method for lowering the amount of radon in the air inside indoor areas. On the other hand, a ventilation system requires about 50% of the energy consumed in a building. Therefore, a suitable design for the ventilation rate and providing practical solutions can cause the achievement of two significant goals i.e. indoor air quality and building energy saving. In this study we investigate the possible solutions for radon concentration reduction in homes in order to minimize energy consumption in ventilation systems.

II. RADON IN THE HOMES

Radon is present in almost all Climates, and all people inhale (a little) radon every day while those who inhale it too much are exposed to the risk of lung cancer more. Radon can enter buildings through building materials, the cracks in the building, joints, the empty space in the buildings, the cracks in the wall, the empty space around the pipes and joints in the wall and the floor, underground water, and heating systems and ventilators – air pressure is often lower inside the home than outside it.

The appropriate insulation for reducing a waste of energy in new buildings increases the level of radon. Another reason for such an increase is building the homes on uranium-rich soil in a way that the amount of radon is even higher in the basements and the first floors closer to the ground. Depending on the local geological characteristics in some areas, radon dissolves in underground water and is released into the air when the water is used.

Materials and Methodology

I. THE DOSIMETRY CALCULATIONS OF RADON DANGERS

Among the three natural radon isotopes, i.e.^{222}Rn, ^{219}Rn and ^{220}Rn, only ^{222}Rn ($t_{1/2}$ = 3.8 day) is able to reach the Earth's surface [5]. This isotope exists in the ^{238}U decay chain. It shoes in Fig.(1).

Using the computational code MCNP4c [7] and the mathematical phantom ORNL which is the mathematical model of the human body. It shows in Fig (2). This shows the anterior view of principal organs in head and trunk of phantom. Analytical models of the human body (called human phantoms) were described in ORNL publications [6]. These phantoms are basically solid-geometry models that describe exterior and interior anatomical features of a human body using analytical equations. Human phantom consists of three types of tissues: skeletal, lung and soft, with different densities and elemental compositions [8].

The dose absorbed by the organs of an adult human who was exposed to the gamma and beta rays of radon over a year were calculated, and the results indicated that the highest doses were absorbed by the lungs, the heart and the esophagus[9]-[12].

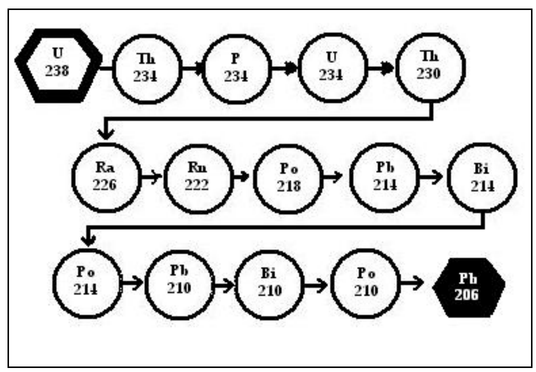

Fig.1 ^{238}U decay chain

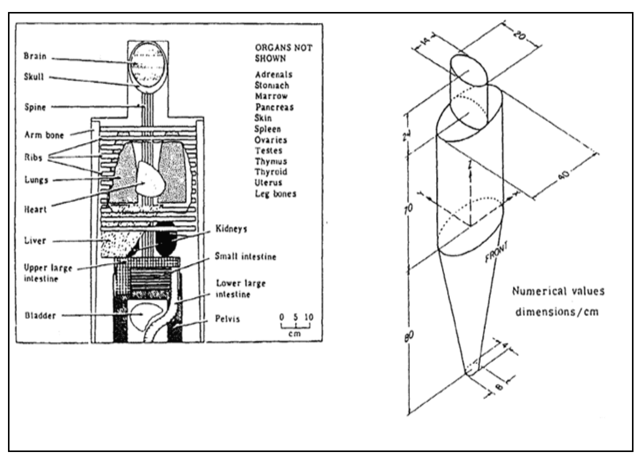

Fig.2 Disposition of organs in human Phantom of Snyder et al. (1969).

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Since the danger of radon comes from its alpha radiation and the radiation dose of alpha is much more than those of beta and gamma, it can be concluded that one cannot afford to neglect the danger of radon in an indoor place when the concentration of radon is too high or when the human is exposed to the long-term radiation of radon. Hence, it is imperative to take basic steps to reduce the level of radon in an indoor place.

II. Energy Saving Simulation

The best way to reduce the concentration of radon in an indoor area is to use an appropriate ventilation system. In fact, ventilation is a good way to decrease the amount of radon in the air of such places in a way that the concentration of the present pollutants in these places has an inverse relationship with the ventilation rate. The problem is that ventilation uses 50% of the energy in a building.

The more fresh air enters a building from outside, the higher the quality of the air inside is. However, that is true as long as the air outside is not polluted. The energy used by a ventilation system especially in colder areas is more than half of the total consumed energy; in addition, the heating and ventilation systems and the weather conditions affect radon concentration.

Ventilation also affects the amount of pollutants outside a building like a home. Research has shown that building sources account for 40% of the total pollution in the environment [13-14].

Pollutant control can be obtained using ventilation to dilute pollutant concentrations. Pollutant concentrations are inversely proportional to ventilation rates. Thus reducing concentrations 50 percent (1/2 of the original values) require twice the initial ventilation. Reducing the concentration by 90 percent (1/10 of the original value) would require ten times the ventilation [14].

With the advancement of technology and science, the construction of new buildings is directed toward an increased level of heating insulation. Moreover, the use of decorative stones inside buildings makes using a ventilation system more important.

So it is desirable to create an optimum condition in which there is good-quality air with a low level of radon inside buildings along with saving energy.

To compromise between indoor air quality (IAQ) and building energy saving (BES), there are several methods that they can be used, with respect to special situations, like local or spot ventilation displacement ventilation versus mixing ventilation, floor heating instead of radiator system or even heat recovery ventilation by using heat exchanger [14].

For example, the Computational fluid dynamics (CFD), which is a computational application and a good substitute for experimental methods, is used to create an optimum condition of computational fluid dynamics. This research was done by Keramatollah Akbari and Jafar Mahmoudi in 2009. This application is able to simulate air current patterns and the distribution concentration of heating pollutants inside a building in order to find the optimum energy consumption and the pollutants at a low cost [14].

Generally, the main goal of energy saving is to keep a suitable condition with a steady rate of optimum ventilation. Indeed, the optimum point in Fig (3) is the one at which the most appropriate air is provided with the lowest consumption of energy. Too little air flow causes adequate IAQ while a too high flow rate leads to a higher demand of energy.

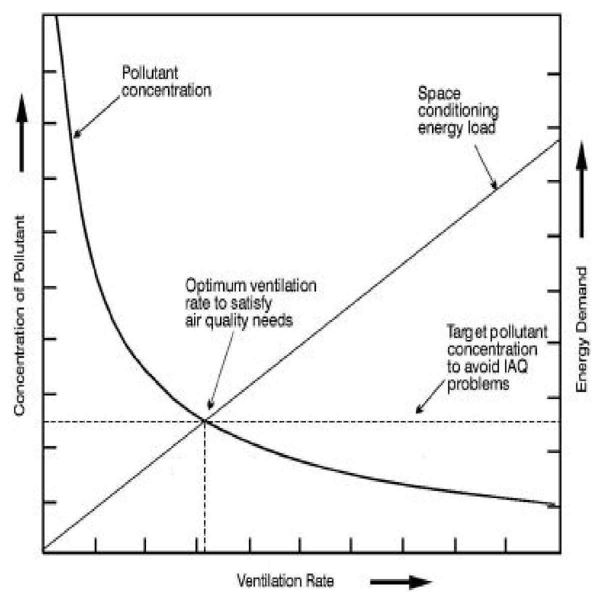

Fig.3 pollutant control based on the ventilation rate and the source energy consumption [14]

III. Results and Discussion

Although the contribution of alpha particles (emitted from radon progeny) in effective dose is about 15 $mSvWLM^{-1}$ [15], just lungs received their absorbed dose and alpha particles cannot be exhaled out of the lungs because of their short range. Photons contribution in effective dose is important because all organs received the photon absorbed dose from radon progeny.

UNSCEAR 2006 reported the radon concentration in Iran. The results showed the minimum and maximum concentration are $82\,Bq/m^3$ and $31000 Bq/m^3$, respectively.

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Based on this results, the effective dose per year (from photons) is $5.76 \times 10^{-1} mSv$ in $31000 Bq/m^3$. Therefore, this value is comparable with $1 mSv$ (The annual allowable effective dose) [16].

Corresponding to these results, one cannot afford to neglect the danger of radon in an indoor place when the concentration of radon is too high or when the human is exposed to the long-term radiation of radon.

Tablae 1. The annual absorbed dose of photon emitted from radon progeny based on UNSCEAR 2006 radon concentration measurement in Iran[12]

Oragans	Annual effective dose of photon from radon progeny $\mu Gy/year$
	$31000 Bq/m^3$
Kidneys	107.52
Pancreas	226.34
Small Intestine	33.61
Adrenals	304.48
Gall bladder	110.82
Heart	554.40
Skin	66.61
Thyroid	152.65
Stomach	165.75
Bone surfaces	106.79
Lungs	1544.99
esophagus	541.85
Bladder	8.543
Thymus	379.70
Liver	262.84
Brain	18.08
Colon	27.97
Breast	335.08
Uterus	15.77
Ovaries	16.76
Testes	2.99
Red Bone Marrow	118.60
Muscle	126.76
Spleen	218.09

As expected, the results in table (1) show that the lungs being the source receive the highest absorbed dose than other organs. The second and third highest dose after lungs is received by the heart and the esophagus, respectively, because both of them are located close to the lungs.

So It is necessary to take major steps to reduce the level of radon concentration inside buildings down to an acceptable level, and save energy at the same time, which is all for pursuing the goal of energy saving properly. Overall, radon can be handled with a minimum use of energy in ventilation systems in indoor areas through the following methods and steps:

1-Prioritizing the discovery and examination of the paths and cracks of radon penetration

2-Using plastic covers under foundations during construction

3-Improving the ventilation system of indoor areas especially enhancing ventilation at lower levels and the floor

4-Insulating and filling the cracks in the walls and floors against radon penetration

5-Using radon drainage under building floors to lead radon out directly

6-Installing an air pressure regulator to increase the air pressure inside building against radon penetration and minimize the effect of low air pressure inside buildings

7-Using concrete mixtures with a high density as well as

8-using compact cinder blocks instead of the hollow ones

9-Doing the radioactive analysis of building materials before construction

CANCULATION

A investigation on radon dosimetry from radon progeny was performed. Hence, the danger caused by radon progeny in places with a high concentration of radon cannot be ignored. It is thus suggested to take necessary measures in such places to reduce the concentration of radon with optimum or minimum saving energy. If we take the preventive actions above to avoid the entrance of radon into residential building more seriously and basically, the consumption of energy used by a stronger ventilation system which uses more energy decreases. Thus, the main objective which is to minimize the threat of radon to human health is accomplished.

REFRENCES

[1] UNSCEAR, source *and effect of ionizing radiation*, United Nations Scientific Committee on the Effect of Atomic Radiation. Report to general, assembly with annexes, (2000).

[2] M.WILENING,"RADON IN THE ENVIRONMENT", Elsevier scince publishers B.V, 1990

[3] A.Abbasnezhad,"Environmental Impacts and Implications of Radon-222, and Its Urgency Attention in Iran", Geology Department Shahid Bahonar University, P.O.Box:76175-133, Kerman, Iran

ISSN (Online): 2305-0225
Issue 16(4), September 2014, pp. 503-507

[4] A.Cavallo,"the radon equilibrium factor and comparative dosimetry in home and mines", Radiation Protection Dosimetry, (2000), Vol 92, No4, pp.295-298

[5] Table of Radioactive Isotopes. Periodic Table linked to decay data for known isotopes of each element. Available on http://ie.lbl.gov/education/isotopes. html last accessed on December 15, (2008).

[6] Hashem Miri Hakimabad* and Lalle Rafat Motavalli," EVALUATION OF SPECIFIC ABSORBED FRACTIONS FROM INTERNAL PHOTON SOURCES IN ORNL ANALYTICAL ADULT PHANTOM", Radiation Protection Dosimetry (2008), Vol. 821, No. 4, pp. 134–724

[7] Briesmeister JF. MCNP - A general Monte Carlo N-Particle transports Code. Version ٤C Ed. Los Alamos New Mexico: Los Alamos National Laboratory 2000.

[8] Ulanovsky AV, Eckerman KF. Absorbed fractions for electron and photon emissions in the developing thyroid: fetus to five-years old. Radiat Prot Dosimetry. 1998;79(1-4):419-24.

[9] K.N. Yu, B.M.F. Lau, D. Nikezic," Assessment of environmental radon hazard using human respiratory tract models", Journal of Hazardous Materials 132 (2006) , pp.98–110

[10] . Markovic VM, Krstic D, Nikezic D. Gamma and beta doses in human organs due to radon progeny in human lung. Radiat Prot Dosimetry. 2009; 531 (3):197-202.

[11] Shila Banari Bahnamiri, Reza Izadi Najafabadi, Seyed Hashem Miri Hakimabad, "The Monte Carlo Assessment of Photon Organ Doses from 222Rn Progeny in Adult ORNL Phantom ", Iranian Journal of Medical Physics, Vol 9, No.2,Spring 2012, 93-102

[12] Shila Banari Bahnamiri, Seyed Hashem Miri Hakimabad ,Reza Izadi Najafabadi, electron dosimetry using variance reduction with OPRNL phantom,pp:٣٦-٢٨ ،٦٢ ,1391

[13] David T. Grimsrud, Daniel E. Hadlich, and Patrick H. Huelman 1996 Assessment of Radon Mitigation Methods in Low-rise Residential

[14] Keramatollah Akbari, Jafar Mahmoudi, Influence of residential ventilation on Radon mitigation with energy saving emphasis, Scientific Conference on "Energy system with IT" March ,2009, Stockholm, ISBN number 978-91-977493-4-3

[15] Nikezic D, Yu KN. Micro dosimetric calculation of absorption fraction and the resulting dose conversion factor for radon progeny. Radiat Environ Biophys. 2001; 40(3):207–11.

[16] International Commission on Radiological Protection. Human Respiratory Model for Radiological Protection. Ann ICRP. 1994;24:1-120.

[17] International Commission on Radiological Protection. Human Respiratory Model for Radiological Protection. Ann ICRP. 1994;1:42-21

[18] David T. Grimsrud, Daniel E. Hadlich, and Patrick H. Huelman 1996 Assessment of Radon Mitigation Methods in Low-rise Residential Buildings

[19] HVAC Systems in the Current Stock of US K-12 Schools, U.S. Environmental Protection Agency, EPA-600/R-92/125.

[20] Nuess, M. and R. Prill (1990). "Radon Control - Towards a Systems Approach." Indoor Air '90, Toronto, ICIAQC Inc

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Analysis of a hybrid building in Kerman

Fatah Nazari, Aref Araghizadeh

***Abstract*—**In this paper has been paid to investigates a hybrid buildings (solar-Fossil) in Kerman. Amount of thermal load is calculated in the two positions of typical walls and insulation walls. Then, according to the consumer of hot water is calculated hot water thermal load of building. From a Catalog is considered a solar collector and amount of energy extracted from this collector is calculated. Meanwhile, the number of collectors required to be installed on a building is determined. Also, due to limited the roof number of collectors installed on the roof and also amount of Percentage of hybrid is estimated in this building. The results of this study is that the total thermal load of requirements in Conditions of insulated and non-insulated 561036 Btu/h.ft^2 to 952102 Btu/h.ft^2 respectively. However, the rate of energy extraction from the per unit collector area is estimated to equal to 926 Btu/h.ft^2.

***Keywords*—**Thermal load, insulation, solar collector, collector number required, recoverable energy collector.

I. Introduction

With the increase in population and technological development in all countries of the world is also increased energy consumption too. One challenge that recently all countries faced by is finitude of fossil fuels, for this reason, researchers today has prompted research on alternative renewable energy. This energies also have less environmental pollution and are renewable too. Nonrenewable resources are divided into two categories. Nuclear sources and fossil sources including: coal, oil and natural gas, each of which in turn can have detrimental effects on the environment. The most damaging effects of the environment is the use of coal and oil and the most damaging effect on wildlife is related to the nuclear fuel in the long run their show. Excessive use from the fossil resources has caused collide the Earth's ecosystems that Including natural disasters have occurred in recent years can be pointed continuous droughts, ozone hole, global warming earth, floods and floods, Forest fires and … [1, 2]. According to statistics provided by the World Health Organization, the direct and indirect effects of climate change led to the deaths of 16 people per year and this rate will be doubled until 2009. Climate change caused by natural disasters such as floods, droughts, significant changes in atmospheric temperature and outbreaks of infectious disease.

Due to the increasing urbanization in the world and domestic, public, commercial and office uses along the urban industries need to review and finding ways of meet the energy needs through renewable sources (green energy), has been attention more than before [3]. In the Table 1 has been shown compares the effectiveness of different types of energy sources on the environment [4].

Tab. 1 compares the effectiveness of different types of energy sources on the environment.

Sources of Energy	Wildlife	Air Pollution	Climate Change
Coal	Very much	Very much	Very much
Oil	Medium to high	Medium to high	high
Natural Gas	Low to high	Low to high	Low to medium
Biomass	Low to high	Low to medium	Low to high
Wind	Near zero	Near zero	Low
Sun	Near zero	Near zero	Low
Geothermal	Near zero	Near zero	Low
Nuclear	high	Near zero	Low

According to the table 1, most adverse environmental changes is related to fossil fuel that In the meantime, coal accounted for the highest ranking in terms of destruction and nuclear energy has the greatest destruction of wildlife. According to the table, we can say the least adverse effects related to renewable energy sources, respectively sun, wind, geothermal and biomass have the least impact. Use solar energy in providing hot water consumption of homes and industrial centers, one of the most practical and most cost effective ways of using renewable energy in the world today, that's why most developed and developing countries are investing massively in this context. Equipment simple and inexpensive, lack of little requiring to maintenance, high efficiency and the possibility to produce and quick and easy installation, and also allows operation of all communities are for using the system strong reasons of this plan.

Industrial countries to have achieved these results with energy efficiency in the industry and buildings can reduce energy consumption by 30 to 40 percent. In the surveys

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conducted by the World Bank states that if the developing countries had a common policy optimize energy consumption to 1991 could be save equivalent 4 million barrels of oil per day, about 15 percent of their business energy [5]. Including ways to optimize fuel consumption is discussed walls insulation and solar heating in this paper. The building of exemplary case study is considered in Kerman. On average sun per second 1.1×10^{20} kWh emits energy, of the total energy emitted by the sun, only 47% reaches the earth's surface.

According to the above statistics, it can be concluded that a three-day solar radiation to the earth equivalent all the energy caused by the combustion of total fossil fuels in the heart of the earth. If the only one percent of the world's deserts could be occupied by solar thermal power plants, energy produced would be enough to provide of total world's annual electricity. Iran is located between the orbits of 25 to 40 degree north latitude that this area is in terms of solar energy received at the earth, in the highest ranks so that the amount of solar radiation in Iran In between 1800 to 2200 kWh per square meter is estimated to be much higher than the world average. Also, the annual on average more of 300 sunny days in Iran is reported to be very significant.

This figure represents potential of possible the highest in land, especially in iran in order to use of solar energy. Iran is very rich to in terms of receive solar energy and use this energy for your needs and incoming solar energy is about 4000 equal power consumption, we can all use solar power to supply the country's needs [6].

II. Providing Hot Water Needed

Sanitary Providing hot water requirements, especially for remote areas that do not allow to them fueling, solar water heaters are done. Water and space heating in buildings totaling more than 80 energy consumption, so more than one third of total world energy consumption is used in order to heating. Among these water heating on average 20 to 30% of energy consumption in the home. Therefore, using solar water heater can be provided annual 60 to 70% energy requirements for water heating. Solar water heater is a device that by absorbing solar energy makes heat water needed. The use of solar energy order to heat water in order to free this energy bonanza, in terms of economy is very affordable.

Solar water heaters have several models including thermosyphon water heater and pump water heater. Figures 1 and 2 are represents these heater. Solar water heater with high capacity can be used for supplying hot water of the required bath. There's few years in Iran because of convenient location for the installation of solar water heaters are used for hot water supply the required. Including the provinces of Iran, which is already are used this system can be noted the province of Sistan and Baluchistan, Yazd and Kerman [7].

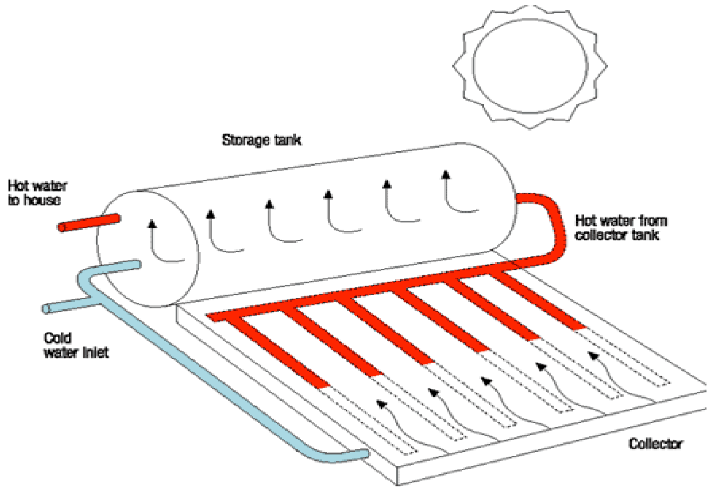

Fig. 1 schematic of a thermosyphon water heater

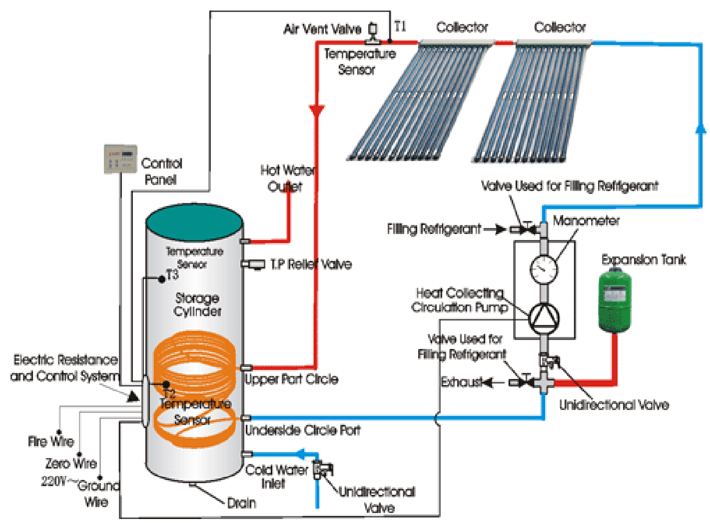

Fig. 2 schematic of a pump water heater

III. Data and Initial Data

The sample hybrid building has studied in this article, a house area of 100 square meters that 80 square meters of which is equipped with heating equipment. Hourly temperatures of 1 January is presented in Table 2. Plans and cross-sections of wall is shown in figure 3.

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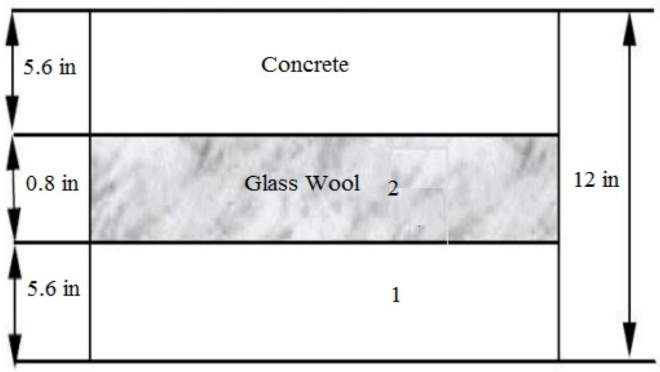

Fig. 3 A section of the surface wall

Tab. 2 Hourly thermal load of 1 January

hour	Non-insulation load	insulation load	hour	Non-insulation load	insulation load
1	25816	5143	13	9840	2579
2	26810	5302	14	11298	2813
3	27805	5462	15	13344	3141
4	28184	5523	16	13923	3234
5	26216	5207	17	16080	3580
6	24558	4940	18	17397	3792
7	22180	4559	19	19432	4119
8	18496	3968	20	20711	4323
9	16070	3578	21	22117	4549
10	13024	3090	22	23316	4741
11	10393	2661	23	24700	4963
12	8860	2421	24	25232	5048

IV. The Overall Coefficient of Thermal Conductivity

For calculate this factor is used the following equation.

$$U = \frac{1}{\frac{1}{f_o} + \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{f_i}} \quad (1)$$

R (Concrete): 0.86 (Per inch of thickness), R (Plaster): 0.32 (Per inch of thickness), R (glass wool): 4 (Per inch of thickness).

$\frac{1}{f_o}$ (Winter): 0.67 and $\frac{1}{f_i}$ (Winter): 0.25

Because the concrete sections is 5.6 inches, so R=4.816 is and thickness of the plaster layer inches to be considered 0.375.

According to the above numbers, will be obtained the value.

V. Calculation of Thermal Loads for Walls, Insulation and Non-Insulation

Thermal conductivity of brick and glass are according to standard tables of 0.26 and 1.13 respectively [8]. The area of floor, roof and also the area of the walls and windows in every space are provided in the table 3. Outside design temperature is considered 78 degrees Fahrenheit.

In the next stage determine the coefficients of thermal conductivity, thermal load resulting from the walls, windows and roof from equation (2) and load resulting from influence air are calculated from equation (3).

$$Q = UA\Delta T \quad (2)$$

$$Q = A \times 0.0749 \times 0.241 \times \Delta T \quad (3)$$

$$V = v \times n \quad (4)$$

Tab. 3 The required areas

Window (m^2)	Door (m^2)	Wall (m^2)	Roof (m^2)	floor (m^2)
18	15	170	80	80

Tab. 4 Hourly thermal load

hour	Thermal load of non-insulation	Thermal load of insulation	hour	Thermal load of non-insulation	Thermal load of insulation
1	25816	5143	13	9840	2579
2	26810	5302	14	11298	2813
3	27805	5462	15	13344	3141
4	28184	5523	16	13923	3234
5	26216	5207	17	16080	3580
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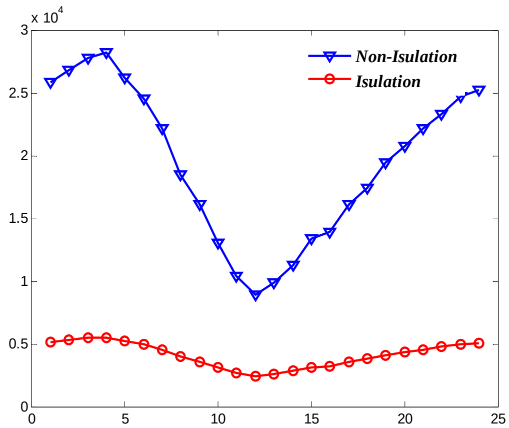

Fig. 4 Thermal loads in conditions insulation and without insulation

VI. Load Calculation of Consumption Hot Water [8]

To calculate of consumption hot water should be determined the prime factors of hot water consumption in the building. In this research include: 2 pcs to sink dishwashers, 1 shower units, 3 units, Amenities and toilet. In table 5 is presented hot water consumption of each consumer.

Tab. 5 Amount of hot water consumption

Consumers	Number	GPH	Maximum consumption
sink dishwashers	2	15	30
shower units	1	100	100
Amenities and toilet	3	3	9

As you can seetotal of these expenditure was equal to 139 for Load calculation first this number multiply factor of demand and then by equation 5 calculated load for hot water consumption.

$$Q = V \times 8.33(t_2 - t_1) \qquad (5)$$

Here:
Q: Thermal load of consumptive hot water (Btu/Day)
V: The amount of consumptive hot water per day according gallons per hour
8.33: Specific weight of water (pounds per gallon)
t_1: Water temperature inlet to the water heater (60 F)
t_2: Water temperature output to the water heater (140 F)

Method of calculation is as follows.
Amount of consumptive hot water: 0.35×139=48.65
Consumptive hot water load: 48.65×8.33(140-60)=32420 Btu/Day = 8105 Kal/Day

Now, assuming a 15-hour Daily functioning the amount of water consumed daily is equal to:
32420×15=486300 Btu/Day = 121574 Kal/Day

For the focus on the computation is used from a special collector for all the roof of model hybrid house. Technically, this collector is presented in Table 6.

Tab. 6 Technically collector used in this study

Width	907mm	Multi-layer insulating d:		Absorber	Aluminum EVIDAL
length	2207 mm	60 mm FCKW- free PU-foam with aluminum foils			Rolland system
height	102 mm	With long wave reflecting foil		Cover frame	Aluminum, continuously
Modul area	2.00 m^2	Thermal conduction coefficient (at 20 C)			Welded, silicon, rubber
Absorber area	1.86 m^2	Absorption coefficient of the selective coating (α)	0.035 W/mK		Seal between glass
Aperture area	1.82 m^2	Emission coefficient of selective coating (ε)	0.93		Frame over entire frame width
Absorber volume	1 L	Cover	0.18	housing	Aluminum, stucco finish
Max operating pressure	2.5 bar	Low-iron hardener safely glass, hail-proof			Corners continuously
Test pressure	6 bar	Temperature resistant up to	300 C		welded
Flow rate	60 l/h m^2	Thickness of pane	4 mm	Heat transfer	3/8 ″O.D.
Max standstill	190 C	Surrounding continuous insulation	25 mm	medium	

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temp					
Weight	46 kg				Glyccl-water mixture

VII. Calculation of Recoverable Amount of Energy a Solar Collector

With the help of equation 6 we can calculate the amount of energy extracted [9].

$$q = \tau\alpha I - U_L(T_c - T_a) \qquad (6)$$

q: Recoverable energy from solar flat collector
τ: Coefficient of light through from the transparent surface
α: Absorption coefficient of the coating
I: Radiation intensity (Btu/h.ft^2)
U_L: Heat loss coefficient from collector
T_c: The temperature generated in the collector
T_a: Environmental temperature

According to the the technical data in Table 5, the collector temperature to 50 °C (about 120 F), absorption coefficient of the collector cover α, 0.93 is considered. According to Table 5, Coefficient of light through from the transparent surface equivalent to 0.916 and environmental temperature and radiation intensity of the hour by hour is defined, respectively from Table 4 and Fig. 4.

According to information in Table 1 the average daily temperature at 1 January is 11.41 F. According to the above numbers, fig. 3 and collector temperature, U_L is for single glass collector in winter 13.1. With placing information of hour by hour in relation 1 initially energy intake of a square meter of collector per hour are calculated and then, taking into account the total collectors area, the total energy received is determined at 1 January. As you was calculated the amount of consumptive hot water load equal to 846300 Btu/Day and thermal load in buildings insulated 98736 Btu/Day and in conditions non-insulation were estimated equal to 465802 Btu/Day.

Accordingly, the total heat load requirements in conditions of insulated and non-insulated is 585036 Btu/Day and 952102 Btu/Day, respectively. However, the rate of energy extraction from collector area is equal to 926 Btu/Day, thus, we have:

Thus, According to the two square meters each of solar collectors in insulation conditions equal to 29 numbers and in non-insulation conditions equal to 47 numbers is determined the number of collectors required.

VIII. Determine the Number of Collectors Considering the Roof Area and Percentage of Hybrid

For determine this ratio are as follows.

1) Inclined roof area with a width of 4.60 meters and length 13.86 meters is equal 63.75 square meters. Considering the fact that the width of each of the collectors 90.7 cm and their length 2.20 meters can be two rows of 14, boundles from collectors deployed on rooftops.
2) As we before, we recoverable amount of energy per unit area from solar collectors was equal 926 Btu/h.ft^2 and According to the area 602.56 ft^2 (56m^2) will have:

602/56×926=557970 Btu/h

According to the the total amount of energy in conditions insulation is equal to 561036 Btu/Day and in conditions non-insulated is equal to 952102 Btu/Day and energy recoverable is from collector equal to 926 Btu/h.ft^2 we can conclude that the in hybridization conditions can be given in conditions insulation 95% and in non-insulation 58% supplied energy needs by the sun.

IX. Conclusion

With insulation walls of building can save as much as 367066 Btu/Day per day. Considering to Figure 2, if the use of Insulation materials and Double glazing thermal load changes during the day is less than without insulation. Extractable amount of energy per unit area from solar collector is equal 926 Btu/h.ft^2. According to the limitations of rooftop used for installation of solar collectors, this collector number than 29 numbers for insulation condition and 47 numbers for non-insulation condition is reduced to 28 numbers. In this case, 95% in the insulation condition, and 58% in non-insulation supplied energy needs of the building from the sun's energy and the remainder from fossil fuels.

References

[1] Alahi, R. “An overview of the most important bio-energy and environmental benefits them,” First National Conference on Planning and Environmental Protection, Vol. 1, 2013, pp. 1-9.
[2] Torkjezi, M. “Utilizing solar system in the building, a new approach to optimize energy consumption,” First National Conference on Renewable Energy and Clean Hamadan, Vol. 1, 2013, pp. 1-8.
[3] Tafghad Akbarpur, M. “Climatic characteristics using Dmartn of solar energy to replace conventional fossil fuels industry in the city of Karaj,” First National Conference on Planning and Environmental Protection, Vol. 1, 2013, pp. 1-11

ISSN (Online): 2305-0225
Issue 16(4), September 2014, pp. 513-518

[4] Ghadimi, R. “Reconsider the necessity of alternative energy sources and new energy review solar power and its role in the rural development,” Second Conference on Planning and Environmental Management, Vol. 2, 2011, pp. 1-9.

[5] Hajsoghta, A. “Principles and applications of solar energy,” publishing University of Science and Technology, 2001,

[6] Bahadorinejad, M, “Solar power station in Iran,” Journal of Mechanical Engineering, 1991.

[7] Nazari, F., Keshvari, M. A., Rezaei, S. “Evaluation of new energy, clean and renewable, and the importance of using them,” First National Conference on Renewable Energy and Clean Hamedan, Vol. 1, 2013, pp. 1-17.

[8] Tabatabaei, M. “Calculations of facilities, buildings,” Fifth Edition, 1996.

[9] peter j. lunde. “Solar Thermal Engineering,” Space heating & hot water systems, 1980.

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Evaluation of potential hazard of infected local carp consumption by women and children in Anzali lagoon by of PHQ modal.

*M. Panahandeh & R. Vahidi

Abstract— Heavy metals for their poisonous susceptibility in more than permissible level are being considered as a great concern of environment. Metals enter to environment through many ways like industrial activities. In present investigation three unnecessary heavy metals such as lead, cadmium and chromium were measured by spectrophotometry method in muscle tissue of local carp. The mean of lead, cadmium and chromium concentration in muscle tissue were respectively 1.56±0.44, 0.16±0.04 and 0.83±0.11 µg/g, and the possibility of potential hazard of consuming this fish was evaluated according to instruction of U.S.A environment conservation organization. The obtained amount of heavy metals concentration in local carp was (0.31µm/g) more than international standards (0.3 µg/gwet weight) in 2007 .in addition, according to obtain results the most of daily consumption dose was for lead element.
In present study children more than women were under risk of carp consumption. Nevertheless estimating of potential risk of all elements showed less than 1 for native in habitants which shows that consumption of local carp has no peril for consumers.

Keywords— heavy metals, potential hazard, spectrophotometry, World health organization

I. Introduction

Contamination of water ecosystems with heavy metals is one of the most important issue which was critically consumption in last recent years and wide range of studies have been done in this subject matter. These ecosystems are the last receiver of heavy metals [1]. Anzali lagoon is one of the most important ecosystem were todays has lost it's biological efficiency for aquatic organisms and human utilization.

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Although some manners are being used to reduce the contaminations of lagoon , but these methods are time energy consuming or they may cause other environment pollutions[2].Heavy metals may remain as solution or suspension in water, sediment in deep or be absorbed by living organisms. Fish can directly swallow or receive them indirectly through soluble compounds [3].
The concentration of elements in fish body is effected from some factors like season, biological condition, nutrition sources, environmental conditions like water chemistry, Salinity, temperature and pollutants[4].
Since one of the most important way of humans hazard from metals like lead, cadmium and chromium is food resource, evaluation and control of pollutions in different foods and identifying the source of pollutants, adjustment or omitting of these ingredient have great effect on health and longevity of humans. Plenty of reports have been published about different pollutions evaluation methods by different countries including Iran[5,6]. Fish has an important role on people's diet in north of Iran. Children and women are more vulnerable. Therefore we decided to study the potential hazard of carp consuming which contains three unnecessary heavy metals such as lead, Chrome and cadmium.

II. Materials and Methods

A. Review Stage

The local carp samples were collected from the Anzali logoon in north of Iran. They were preserved in laboratory condition and after determination of biological properties the separated muscle tissue for 24 h kept in 80-100$^{\cdot c}$ splendor and then was powdered by mortar. 0.5 g of this tissue was taken by 0.00001 accuracy scale. With 4cc aquafortis and 1cc *pro-chronic* in 120$^{\cdot c}$ heater digest was chemically digested. Then the samples were passed through the watman paper 42 and solved in 50cc distilled water [7].
Control samples for error determination were prepared. All samples were estimated by atomic observed machine (Shimadzu AA/68) with deuterium lamp for back ground correction and air flame acetylene. For calibration line drawing we used standard solution with different density, made up of 1000 ppm stock standard. For data accuracy

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evaluation standards Reference Materials were used. Metals recovery for lead, cadmium and chromium was respectively 89.6, 99.4 and 96.Statistic survey has done by excel 2007 software. For prediction of potential risk of heavy metals in children and women in addition to metals consumption in muscle tissue of fish, we compared it with instruction of American environment protection agency.

A. Estimation of daily consuming rate

DI (mg/kg-bay)=(C×IR×EF×ED)/(BW×AT)

Table 1. Parameters for potential risk of heavy metals which are accumulated in local carp muscle, for children and women.

Parameters	**Children**	**Women.**
Daily consuming dose(DI)	-	-
Metal consumption in fish	-	-
Body weight(kg)	30	67
Exposed frequency(day)	365	365
Fish consuming rate	2.83	5.61
Expiring duration(year)	15	30
Mean of days for Carcinogenic and non-carcinogenic materials	ED/EF	ED/EF

B. Potential risk according to EPA instruction:

Finally we measured the hazard in base of one, PHQ <1 means that the consumption if that fish is potential dangerous for human being. We can obtain the potential hazard in wet weight of fish by this relation:

$$\mathbf{PHQ = DI/oral\ R_{fd}}$$

Potential hazard quotients: potential risk from non-carcinogenic materials for human.
DI: daily consuming dose(mg/kg-day)
Oral R_{fd}: dose of chemicals oral consumption
Also the analysis of data has done by SPSS16 and excels software.

III. RESULTS AND DISCUSSION

The length of consuming is 145-305 mm and the range of body weight variation was 45-366 g (Table 2).
The mean concentration of lead, Cadmium and chromium in local carp muscle tissue respectively were: 1.56±0.44, 0.16±0.04,0.83±0.11(Table 3). Obtained density of lead in local carp (0/31mg/wet weight) is much than global (0.31mg/wet weight) cadmium was less than the global standard (0.2 mg/wet weight).
Daily index of children and women has considered as time and frequency exposition. Lead and cadmium have respectively the most and feast consumption index in local carp of Anzali lagoon .The result of potential hazard of fish consumption by children and women is represented in Table 4. The amounts less than 1 mean that the consumption has no potential risk for human.

Table 2. Physical properties of local carp in Anzali lagoon, the mean and standard division and range of variation.

Parametr	**Mean**	**Range of variation**	**Standards division**
Body length(mm)	240.30	305-145	56. 95
Weight(g)	214.9	226-45	118.90

Table 3. Metal concentration mean, chromium and chromium with standards division.

Fish	**number**	**Chromium**	**cadmium**	**lead**
local carp	30	0.83±0.1	10.16±0.04	1.56±1.44

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Table 4. Consumption dose rate and potential hazard of infected local carp of Anzali lagoon for children and women according to USE PA 2000 standards (µg/kg).

Pollutant	**acceptor**	**daily consumption rate**	**Potential Hazard value**
Cadmium	Women	0.0270	0.0520
	Children	0.0003	0.830
Chromium	Women	0.0140	0.0670
	Children	0.0150	0.1070
Lead	Women	0.0200	0.0010
	Children	0.0290	0.0020

From all acceptors women and children different age groups, children are much exposed to potential hazard as it is shown in diagram (Fig.1). Nevertheless the obtained amounts are less than 1 and could not have remark able risk.

Living thing basically vary in heavy metals absorbance, accumulation, taking and detoxification. Some species which have metallothioneins and lysosomes can destroy the toxicity of metals. [9, 10].

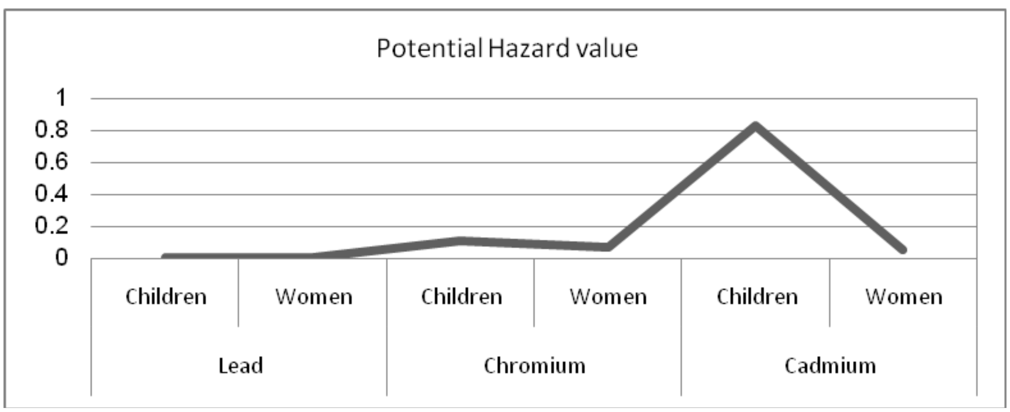

Fig 1. Comparison of potential hazard value of metals in consumed local carp muscle tissue by children and dwelling women in Anzali lagoon.

Fish is a useful part of food habit [11, 12] However, the adverse effects of cadmium, lead and other heavy metals have been evaluated by many researchers [6,13].
Metals density in muscles is less than other parts of body. Since the consumption of muscle is more than other members the risk of metals increases. according to collected data and theories of American environment conservation organization The most and least existent amount of metals in Anzali local carp refers to lead and with following relationship presence of three hazardous metals could hurt-under 14 year old-children and between 14-44 years old women, lead> cadmium>chromium.

Potential adversity of metals warns us to use less amount of contaminate materials and also have variety of food rather than same diet for most meals. In addition it is required to improve public awareness about heavy metals pollutant in fish to select a healthy diet with the least amount of metals.
In countries like U.S.A organizations like drug and food organization by designing of proper consumption pattern are preventing the problems of heavy metals in seafood. In Iran it is necessary to increase the fish consumption capita share and also pay critical attention to food safety. Fish and aquaculture research centers to measure the healthy quality of fish need to do much more research.

REFRENCES

1. Peng, J.F., Song, Y.H., Yuan, P., Cui, X.Y. and Qiu, G.L., The remediation of heavy metals contaminated sediment. J. Hazard. Mater, **161: 633–640**. 2009.

ISSN (Online): 2305-0225
Issue 16(4), September 2014, pp. 519-522

2.Turkmen A., Turkmen M., Tepe Y. & Akyurt I., Heavy metals in three commercially valuable fish species from Iskenderun Bay, Northern East Mediterranean Sea, Turkey. Food chemistry. **91.167-172**. 2005.

3.Mendil D., Uluozlu O.D., Hasdemir E., Tuzen M., Sari H. and Suicmez M., Determination of trace metal levels in seven fish species in lakes in Tokat, Turkey.Food Chemistry. **90:175-179**.2005.

4. Carvalho M.L., Santiago S. and Nunes M.L. Assessment of the essential element and heavy metal content of edible fish muscle.Analytical and Bioanalytical Chemistry,2005 **382: 426-43**.2005.

5. Amini Ranjbar, G. H. & Sh2. ariat, F., Trace metals (Cu, Cd, Zn, and Pb) in the liver and kidney of Acipenser persicus with relation to their concentration in the superficial sediments of the west coast of the southern Caspian Sea. Iranian Journal of Fishers Science. **5: 19-40**.2006.

6. Burger, J. and Gochfeld, M.. Heavy metals in commercial fish in New Jersey. Environmental Research. **99: 403–412**. 2005.

7. Watling R.J. , A menul of Method for use in the South Africa Marine pollution programms . south African National Scientific programmes . **Report 44 , 82 pp**.1981.

8. Pourang N, Nikouyan A, Dennis JH, Trace element concentrations in fish, surficial sediment and water from northern part of the Persian Gulf. Environ Monit Assess , **109:293–316**. 2005.

9. Viarengo A., Heavy metals in marine invertebrates: mechanisms of regulation and toxicity at the cellular level, Reviewes Aquatic Science 1.1989.

10. WHO/FAO., Joint FAO/WHO Food Standard Programme Codex Alimentarius Commission 13th Session Report of the Thirty Eight Session of the Codex Committee on Food Hygiene. Houston, United States of America, Alinorm. 07/30/13.**2007**.

11. Oomen, C.M., Feskens, E.J., Räsänen, L., Fidanza, F., Nissinem, A.M., Menotti, A., Kok, F.J., Kromhout, D., Fish consumption and coronary heart disease mortality in Finland, Italy and The Netherlands. Am. J. Epidemiol. **151:999– 1006**.2000.

12. Kinsella, J.E., Lokesh, B., Stone ., R.A Dietary n-3 polyunsaturated fatty acids in amelioration of Kris-Etherton, P.M., Harris,W.S., Appel, L.J.,. Fish consumption, fish oil. Omega- 3 fatty acids, and cardiovascular disease. Circulation. **106: 2747–2757**.2002.

13. Has-Schön, E., Bogut, I., Strelec, I., Heavy metal profile in five fish species included in human diet, domiciled in the end flow of River Neretva (Croatia).Arch. Environ. Contam. Toxicol. **50: 545–551**.2006.

14. Alam, M.G.M., Tanaka, A., Allinson, G., Laurenson, L.J.B., Stagnitti, F., and Snow, E.T., A comparison of trace element concentrations in cultured and wild carp (Cyprinus Carpio) of Lake Kasumigaura, Japan. Ecotox. Environ. Safe. **53: 348–354**.2002.

15. Environmental Protection Agency , Guidance for assessing chemical contaminant data for use in fish advisories (EPA no. EPA/823/B-00/007). Washington, DC: Office of Science and Technology and Office of Water.2000a

16. MacDonald, DD; Ingersoll, CG; Berger, TA. , Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch Environ Contam Toxicol. **39(1):20B31**,2000

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Qualitative and Quantitative Evaluation of Groundwater in Isfahan Najaf Abad Study Area

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***Abstract*—** In this paper, quantitative and qualitative changes in groundwater of Najaf Abad Plain were evaluated. The quantitative assessment based on data obtained from 48 observation wells showed that the average groundwater level in this plain declined 24.25 meter from 1994 to 2012. Then, the average groundwater level declined averagely 1.28 meter per year. Zonation of the declines in this plain suggested that maximum drop is observed in intermediate aquifer zones. This decline even extends to 85 meters. The minimum drop rate equal to zero was observed in Zayanderood margins. Fifteen operated wells were analyzed physicochemically to evaluate chemical quality of the study area. These evaluations included measuring pH, total hardness (TH), total dissolved solids in water (TDS), electrical conductivity (EC), magnesium (Mg), calcium (Ca), sodium (Na), potassium (K), chloride (Cl), sulfate (SO4), bicarbonate (HCO3). Comparing the results with drinking water quality standards of the World Health organization (WHO) revealed that many water samples could not be categorized as drinking water. Hydro chemical type and profiles using Piper diagram showed that dominant type of the study area is categorized as bicarbonate type with sodic profile. Wilcox diagram results and combining sodium absorption ratio (SAR) and electrical conductivity (EC) indexes showed that only 66.6 of the samples are suitable for agricultural purposes.

***Keywords*—**quantity and quality of groundwater, Wilcox and Piper diagram, the study area of Najaf Abad in Isfahan

I. Introduction

Approximately the easiest way to access water in humid areas with surface flows lies in using the water resources. However, it is either not possible or highly problematic to access surface water in arid zones and deserts and sometimes in semi-arid zones. The easiest way in this regard lies in using the groundwater. The ease of utilization of the groundwater motivated both developing countries and the third world to find appropriate groundwater aquifers to supply water needed for drinking, agriculture and industry. This resulted in nonstop exploitation of groundwater resources, which are sometimes non-renewable. This causes several problems such as drop in ground water level, water quality degradation, land subsidence, increased pumping costs and reduced industrial and agricultural production. Sometimes, the groundwater is contaminated. In many cases, it takes ten decades or more, to eliminate groundwater contamination, so that proper groundwater quality is restored. This is due to extremely long retention time since water moves slowly from the ground to top level. This is due to low rates of pollutants deterioration processes[7].

During the last two decades, extensive studies were conducted in the field of evaluating quantity and quality of groundwater by many researchers in different parts of the world. The results of analyzes carried out on the operated wells located in the northern border of Tamil Nadu, India for determining regression equation between EC and TDS of both saltwater and freshwater suggested a linear correlation between these two parameters in freshwater and saltwater while the correlation between these two parameters in saltwater is logarithmic [10]. In another study conducted in Central Iran in Kashan, it was shown that there is a logarithmic relationship between EC and chlorine [3].

The studies carried out in relation to hydro chemical properties of water and quality assessment of surface water and groundwater in Songen Plain in Northeast China showed that shallow groundwater is suitable for irrigation while groundwater at high depths is suitable for drinking. Drinking water should not have natural ions such as iron and manganese. The Salinity Control due to sodium and suitable conditions for irrigation should also be established in the study area [16]. Groundwater quality may vary during operation or be affected by human activities. These effects may be observed in both long and short-term conditions. In fact, sources of groundwater pollution are unbounded.

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Sources of groundwater pollution are closely related to water consumption by humans [4]. Water pollution can affect type of water consumption by human users [11]. By studying the relationship between rainfall and recharge in Pingtong Plain in Taiwan, it was concluded that decline in groundwater levels caused an influx of saltwater as well as decline in groundwater quality in the studied area [13].
Najaf Abad in Isfahan was only studied by one researcher in terms of optimizing combined utilization of surface water and groundwater resources. The results of the simulation model output confirmed both pivotal and significant role of the river in in feeding the adjacent aquifer when passing through the aquifer [1].

Introducing the area of study
The study area is Najaf-Abad aquifer identified by 4206 code Classification of National Water Master Plan.
This study area and aquifer is a part of large part of Zayandehrud Great Basin whose area is approximately 952.12 square kilometers. This region is located in the central plateau of Iran. This aquifer is located between 57, 50 to 26, 44, 51 along eastern circuits and 13, 20, 32, 21, 49, 32 along north latitude. ZayandehRud passes from Zagros Mountains to Gavkhooni Basin from West to the East with an approximate length of 350 km. This is considered as the main source of water supply for agriculture, industry and drinking water in Isfahan Province. General slope of the sub-basin is from West to East and Northeast. Emberger climatic classification classified this region as cold and dry climates based on average weather information with respect to water years while Do Martin classification classified this zone as arid zones and Koppen classified this region as desert climates, which is accepted by most experts. It is observed that this region is categorized as dry climates according to most existing methods despite relatively rich sources of surface water and groundwater in some parts of the region [9]. Location of the basin is shown in Figure 1. Most precipitation in Zayandehrud Basin is in the form of ice and snow until April when temperature rises. The effect of spring slush is represented as maximum flows during that year and maximum agricultural needs. This denotes irrigation as an economic activity, which is considered as the basis of historical significance of Isfahan for centuries. The average rainfall in the basin is 158 mm, which mostly occurs during winter and early spring. Potential evapotranspiration as 1500 mm makes agricultural activities impossible without irrigation in the basin.

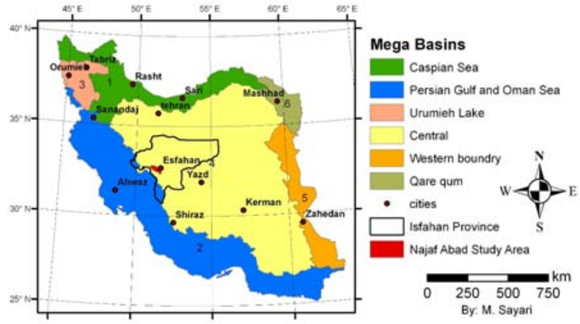

Figure 1: Location of Isfahan Najaf Abad basin

II. Materials and Methods

In order to evaluate the quality of study area, 15 operated wells from 1995 to 2011 were used. Following parameters were measured: pH, total hardness (TH), total dissolved solids in water (TDS), electrical conductivity (EC), magnesium (Mg), calcium (Ca), sodium (Na), potassium (K), chloride (Cl), sulfate (SO4), bicarbonate (HCO3). The experiments were conducted on two general categories of device laboratories and Titrimetric Tests. Titrimetric Tests included temporary and permanent hardness, calcium and magnesium, alkalinity and chlorine. These measurements were performed based on the methods described in standard reference method. Accordingly, total hardness, calcium and magnesium, and titration with EDTAT and alkalinity with titration method by hydrochloric acid or sulfuric acid 0.02 normal were measured. Chloride was measured with silver nitrate titrant and iodometric method.
Device tests also included measuring EC and TDS with EC Meter Device while pH was measured with pH meter device [2]. These tests were conducted by laboratory of Regional Water Organization of Isfahan Province.
Piper Diagram was used after determining concentration of cations and anions in order to determine the type of water. Wilcox Index was also used in order to evaluate the quality of the water in terms of soluble salts for agricultural use. Schuler index was used to evaluate the quality of water in terms of soluble salts for drinking water. Langelier Index was also used to evaluate water quality in terms of soluble salts for industrial users.
The study area was zoned in three sections of drinking, agriculture and industry using GIS software. In addition, 48 observation wells from 1995 to 2012 were used for qualitative evaluation of changes in average groundwater level.

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III. Results and Discussion

In order to evaluate the quality of study area, 15 operated wells from 1995 to 2011 were used. Following parameters were measured: pH, total hardness (TH), total dissolved solids in water (TDS), electrical conductivity (EC), magnesium (Mg), calcium (Ca), sodium (Na), potassium (K), chloride (Cl), sulfate (SO4), bicarbonate (HCO3). The experiments were conducted on two general categories of device laboratories and Titrimetric Tests. Titrimetric Tests included temporary and permanent hardness, calcium and magnesium, alkalinity and chlorine. These measurements were performed based on the methods described in standard reference method. Accordingly, total hardness, calcium and magnesium, and titration with EDTAT and alkalinity with titration method by hydrochloric acid or sulfuric acid 0.02 normal were measured. Chloride was measured with silver nitrate titrant and iodometric method.

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III.I. Quantitative assessment

The data obtained from 48 observation wells was examined to determine average water level in the basin (By Isfahan Regional Water) from 1995 to 2012. Moreover, the data relevant to rainfall in the basin was collected using 2 selected stations in the study area including Zafreh Falavarjan and Tiran. Table 1 shows results of precipitation, the average level of the aquifer, the rate of aquifer depletion and decline each year in the study area of Najaf Abad. According to Table (1), a decline in changes in water table aquifer level from 1995 to 2012 can be observed. The results indicated that average water level declined 1657.63 m in 1994-1995 compared to last statistical years of 2011-2012. An average drop of 1.28 mm per year can be observed here. The main reasons for decreased water level in the basin lies in population growth and drought occurred in two periods from 1998 to 2000 and from 2007 to 2011.

Discharge rate increased from 258.383 million cubic meter per year in 1995 to 757.84 million cubic meters per year in 2012. This shows an average increase of 293% utilization. Figure 2 shows the map of underground water level changes in the last 18 years.

Table 1: Results of quantitative characteristics of Isfahan Najaf Abad study area

Discharge (M.C.M)	Drop (m)	Annual aquifer level (m)	Annual rainfall (mm)	Year	Drop (m)	Discharge (M.C.M)	Annual aquifer level (m)	Annual rainfall (mm)	Year
773/936	+0/7	1642/15	222/4	-2004 2003	-1/28	-	1657/63	272/8	94-95
830/179	+0/99	1642/85	276/5	-2005 2004	-0/24	258/383	1656/35	197/5	95-96
1005/904	+1/38	1643/84	329/8	-2006 2005	-1/68	223/655	1656/11	260/5	96-97
824/268	+1/74	1645/22	146/3	-2007 2006	-0/67	333/8	1654/43	231/8	97-98
697/562	-5/54	1646/96	128/9	-2008 2007	-3/39	626/386	1653/76	131	98-99
760/198	-3/73	1641/42	218/3	-2009 2008	-4/37	544/621	1650/37	153/1	99-2000
721/383	+0/62	1637/69	185/5	-2010 2009	-4/68	391/05	1646/00	217/1	-2001 2000
942/982	-3/18	1638/31	89	-2011 2010	+1/27	554/535	1641/32	223/3	-2002 2001
757/84	-1/94	1635/13	145	-2012 2011	-0/44	653/84	1642/59	239/6	-2003 2002

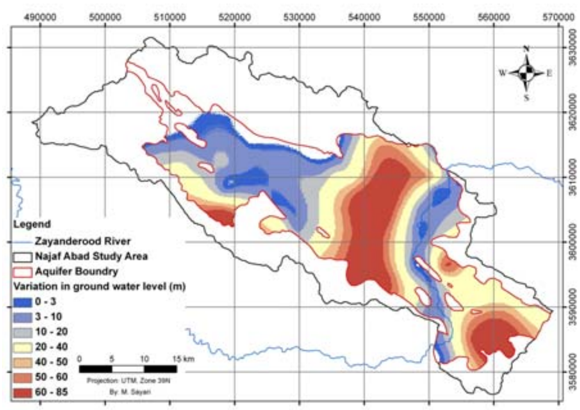

Figure 2: Map of groundwater aquifer differences in Najaf Abad, Isfahan (Oct 1995 to 2012)

III.II. Qualitative Evaluation

One major effects of groundwater depletion and increased utilization of the wells and decreased precipitation and increased number of drought periods in the region during a statistical interval lies in decreased groundwater quality due to increased salinity in the area. Groundwater quality depends on several physicochemical parameters obtained by tests on samples of ground water in the study area. Data obtained from 15 wells operated by the Regional Water Organization of Isfahan Province in 2012 was examined to determine the quality of groundwater for various uses including domestic, agriculture and industry. Chemical parameters measured in the study area are summarized in Table 2.

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III.II.I. pH value

According to WHO guideline [14], the optimal pH for drinking water is between 6.5 and 8.5. PH value in the study area varied from 7.1 to 7.65, which is desirable. PH has usually no direct effect on human health; however, increased pH can cause sedimentation in water pipes and reduce potential to chlorine disinfection. Increased contact time and residual chlorine is required for disinfecting alkaline water with high pH value.

Table 2: chemical analysis results in Najaf Abad study area (mg Aki Valant)

Sampling location	Type	EC	TDS	pH	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	Cl^-	SO_4^-	Symbol
Sia Afshar	Semi-deep	2370	1659	7/1	9	5/4	10/3	0/01	4/8	14/8	5/51	W1
Haji Abad	Deep	2012	1408/5	7/5	7/05	5/25	9/4	0/055	4/25	4/1	13/405	W2
Jozdan	Deep	2089/5	1462/5	7/55	3/45	1/25	15/35	0/55	4/95	9/3	6/35	W3
Jooshan	Semi-deep	999/5	676	7/25	4/45	3/25	2/8	0/055	5/5	2/85	2/205	W5
Vila Shahr	Deep	2940	2058	7/35	9/7	7/9	13	0/35	4/8	16	10/15	W9
Dorche	Semi-deep	1227	858/5	7/3	4/85	3/65	3/55	0/01	6/5	3/1	2/46	W10
Ghale Sefid	Deep	1022/5	715/5	7/6	2/75	1/7	5/45	0/01	4/55	3/05	2/31	W11
Shargh Poli Akril	Deep	13520	9464	7/15	53/2	27/8	67/5	0/15	2/25	117	29/4	W12
Hassna Abad Abrize	Semi-deep	871	566	7/65	3/35	2/25	3/1	0/01	3/5	1	4/21	W14

III.II.II. EC value

Electrical conductivity shows the concentration of ionized substances in water. EC maximum permissible concentration for drinking water is 1400 microseconds per cm. EC value varied between 871 and 13520 in this basin. Map of EC changes in the study area in figure (3) shows high levels of electrical conductivity in the southwestern basin, which is primarily due to geological structure of the region.

III.II.III. Chloride

High concentrations of chloride can increase the corrosion of water pipes and lead to salinity taste of the water. According to World Health Organization guidelines, chloride concentration should be between 400-300 mg. Maximum allowable concentration in drinking water is 600 mg. Chloride concentrations in the study area varied between 35.5 and 4153.5 mg. Changes in chloride concentration in the study area are plotted in figure (4). Considering this figure, the highest concentration of chloride in the study area is observed in southern west part of the Basin.

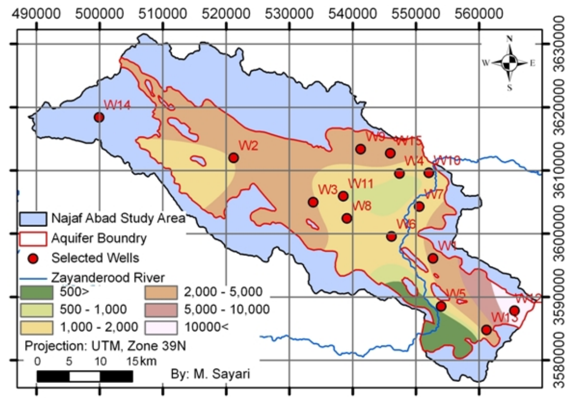

Figure 3: Map of EC changes in the study area

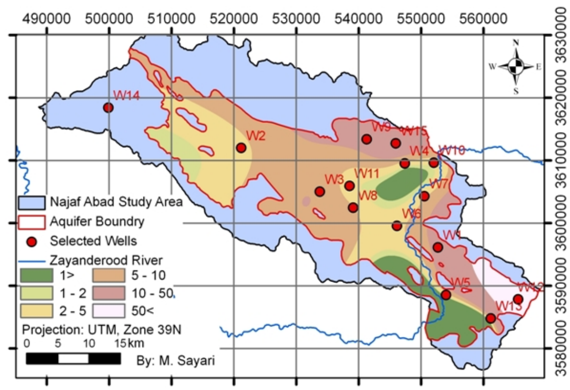

Figure 4: Map of Cl changes in the study area

III.II.IV. Sodium (Na):

According to the WHO guideline, sodium concentrations higher than 200 mg per liter may lead to an unacceptable taste of the water. Sodium content of the operated wells in the study area varied between 64.4 and 1552.5. About 53.3 percent of the wells had sodium content lower than maximum allowable value in the study. Several evidence showed that excessive amount of sodium can cause cardiovascular disease.

III.II.V. Alkalinity

The major factors affecting the quality of water are pH and alkalinity. Alkalinity represents total hydroxide, carbonate and bicarbonate ions. As similar as pH, alkalinity has no direct impact on human health. Alkalinity rates in the region varied between 137.2 and 396.5 mg per liter.

III.II.VI.The amount of sulfate (SO42):

The maximum sulfate concentration recommended by WHO for drinking water is 400 mg. The amount of sulfate in the study area varied between 105.8 and 1411.2. Moreover, 26.6% of the samples had higher than maximum allowable concentration of sulfate in comparison with the standard value.

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III.II.VII.Total dissolved solids (TDS):

Total dissolved solids include inorganic salts (such as calcium, magnesium, potassium, sodium, bicarbonate, chloride and sulfate) and a small amount of organic matter that are dissolved in water. According to data published by the World Health Organization, TDS greater than 1,000 mg significantly reduces the quality of drinking water. TDS concentrations greater than 1,000 ppm can change the scale to construct water pipes and boilers. TDS of the study area varied between 566 and 9464 mg per liter.

III.II.VIII.Total Hardness (TH):

A major part of total hardness consists of total calcium and magnesium ions. Hardness plays an important role in cardiovascular disease in humans. The maximum allowable concentration of calcium carbonate hardness in drinking water is 500 mg. Hardness level in the study area varied between 222.5 and 4050. About 53.3 of the samples were within permissible limit for drinking. Since contact with geological formations is an important factor, which increases hardness, aquifer groundwater branches passing through carbonate formations and origin of the latter within karst springs relatively increased the hardness. According to Table 3, all wells were categorized as very hard.

Table (3) Hardness Scale for drinking water [8]

TH (mg/L as $CaCO_3$)	Description	Number Wells
0-60	Soft	0
61-120	average hardness	0
121-180	Hard	0
More of 180	Very hard	15

III.II.IX. Profile and types of the study area

Chemical profile of the groundwater depends on geological structure, length of retention time and the flow pattern. Groundwater is classified as three main categories of bicarbonate, sulfate and chloride in terms of chemical composition. Piper diagrams can be used to identify the type of water. The dominant type of water in this region is bicarbonate. Chloride and sulfate types are less developed in this region. Then, types of most selected water resources are carbonate with sodic profile in Najaf Abad. Investigation showed that about 73.5% of the samples have sodic profile (Figure 5).

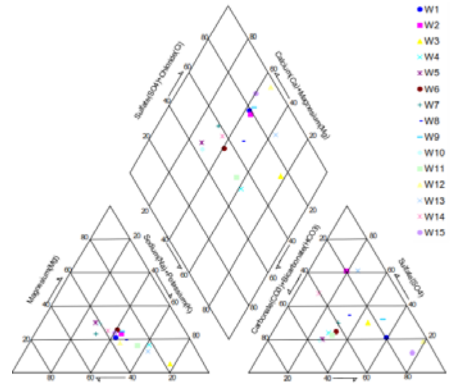

Figure (5): zonation of the study area in terms of drinking

III.II.X. Assessing the quality of water sources in terms of drinking

Chemical water quality assessment was done using Schuler diagrams. According to this diagram, groundwater of the region was categorized into six categories of proper to non-drinkable. Classification of drinking was done using Schuler diagram in Figure (6 and 7) and Table (4).

Table (4) water quality Parameters [5], [6]

Parameter	Proper	Acceptable	Average	Improper	Undesirable	Non-drinkable
pH	7/3	7/8	9	10	11	> 11
Calcium	0-100	100-200	200-300	300-600	600-1000	>1000
Magnesium	0-70	70-120	120-200	200-400	400-800	>800
Sodium	0-100	100-220	220-470	470-920	920-1900	>1900
TDS	0-500	500-1000	1000-2000	2000-4000	4000-8100	>8100
TH	0-250	250-500	500-1000	1000-2000	2000-4000	>4000
Chloride	0-190	190-380	380-800	800-1500	1500-3000	>3000
Sulfate	0-150	150-300	300-600	600-1200	1200-2200	>2200
Bicarbonate	0-200	300-200	300-600	600-1000	1000-2000	>2000

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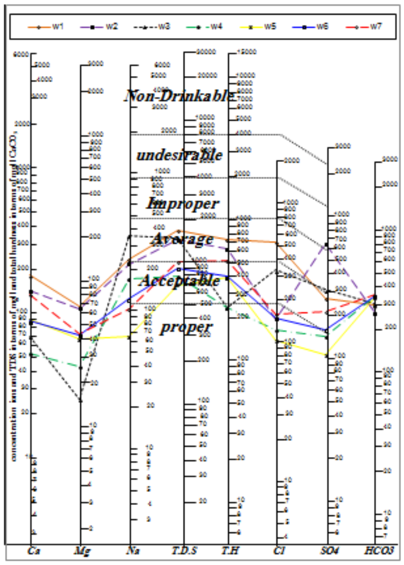

Figure (6): Schuler diagram of the study area (W1-W7)

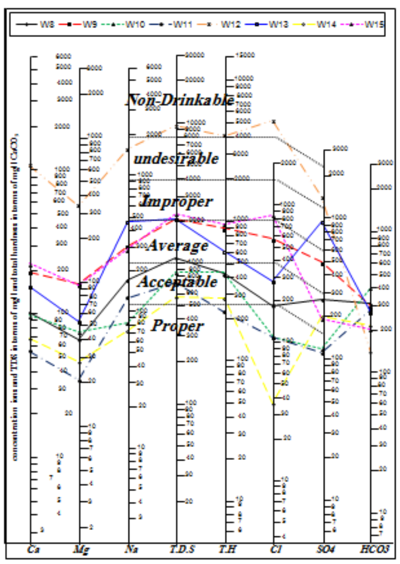

Figure 7: Schuler diagram of the study area (W7-W15)

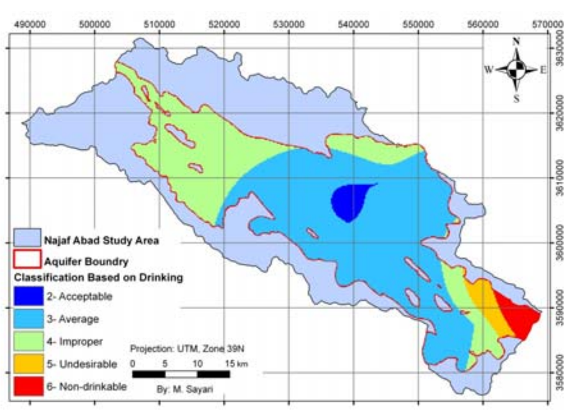

Figure (8): zonation of the study area in terms of drinking

Worst quality of drinking water referred to well # 12, which was Shargh Poly Acryl while the best quality of ground water referred to Ghale Sefid and Hassan Abbad Abrize wells, which were respectively wells # 11 and # 14. Map of zonation of chemical quality of drinking water aquifers in Isfahan Najaf Abad is specified in Figure (8). According to this chart, 53.33% of the samples were categorized as average while 26.6% of the samples as inappropriate, 13.3% of the samples as acceptable and 6.6% of the samples as drinkable.

III.II.XI. Quality assessment of water resources in terms of agriculture

Groundwater quality for agricultural purposes is measured by various indices. The standards used for agricultural water include sodium adsorption ratio (SAR), sodium percent (Na%) and residual sodium carbonate (RSC). Wilcox diagram based on SAR and EC criteria shows evaluation of agricultural water quality in terms of salinity, alkalinity and agricultures with various categories of sodium. This divides water resources into 16 categories [12]. This diagram is shown in Figure (9). In this figure, 9 wells at C3-S1 category (salty - can be used for agriculture), 1 well at C3-S3 category (salty - can be used for agriculture), 3 wells at C4-S2 category (very salty - unsuitable for agriculture), 1 well at C4-S1 category (very salty - unsuitable for agriculture) and 1 well at C4-S4 category (very salty - unsuitable for agriculture) are shown.

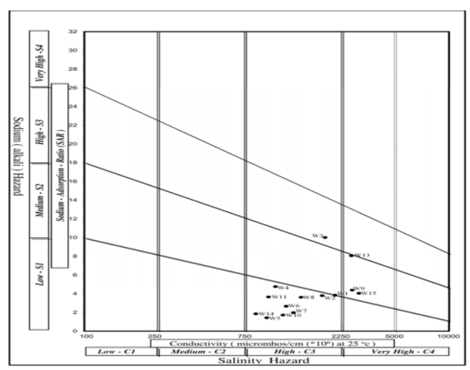

Figure 9: Wilcox diagram of the study area

Based on this index, only about 66.6% of the samples are suitable for agricultural purposes. Figure (10) shows the zoning map of the study area for agricultural purposes. The amount of sodium adsorption ratio (SAR) can be calculated from the following equation.

(1) $$S.A.R = \frac{Na}{\sqrt{\frac{Ca+Mg}{2}}}$$

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Other indicators in relation to assessment of groundwater quality and agricultural purposes are as follows: sodium percentage (% Na) and residual sodium bicarbonate (RSC). Increasing the amount of sodium in the soil resulting from cationic exchange leads to soil hardness, reduced uptake by plant roots and reduced sodium absorption. Increased calcium and magnesium increase the capability and capacity of the soil for agriculture. Results of water quality can be calculated and evaluated based on the percentage of sodium using equation (2). The total concentrations of carbonate and bicarbonate minus the sum of the concentrations of magnesium and calcium give a scale of sodium and potassium carbonate in water (equation (3)). Water with high RSC value has a negative impact on plant growth; as a result, it and is not suitable for agriculture. Water with RSC above 2.5 is suitable for irrigation [15].

(2) $$\%Na = \frac{(Na+K)\times 100}{(Ca+Mg+Na+k)}$$

(3) $$RSC = (CO_3 + HCO_3) - (Mg + Ca)$$

Table 5 details the results of two assessments for agricultural water quality. Accordingly, Na% = 80% and RSC = 100% makes wells suitable for agricultural irrigation.

Table 5: Classification of groundwater in the study area based on RSC and Na%

Quality based on RSC	RSC	Quality based on Na%	Na%	Sampling location
Suitable	-9/6	Acceptable	41/72	W1
Suitable	-8/05	Acceptable	43/46	W2
Suitable	0/25	Questionable	77/18	W3
Suitable	-2/2	Proper	27/05	W5
Suitable	-12/8	Acceptable	43/13	W9
Suitable	-2	Proper	29/52	W10
Suitable	0/1	Acceptable	55/1	W11
Suitable	-78/75	Acceptable	45/51	W12
Suitable	-2/1	Proper	35/71	W14

III.II.XII. Quality assessment of water resources for industry

Langelier related solubility of calcium carbonate to several influential variables in dissolution in 1936. In this definition, a parameter called the saturation index (or Langelier index or sediment index) is defined as IS = pH-pHs by which a tendency to sediment or corrosion by desired water can be evaluated qualitatively. In fact, saturation index represents the difference between the actual pH of water (which is measured by pH meter device) with pH of the water, which is not willing to sedimentation and be corrosive. It is called the saturation pH. Table (6) defines the water quality for industrial use. Accordingly, 80% of the wells tend to sediment and 20% of the wells are willing to be corrosive. Figure 11 shows zoning of the study area in terms of industry.

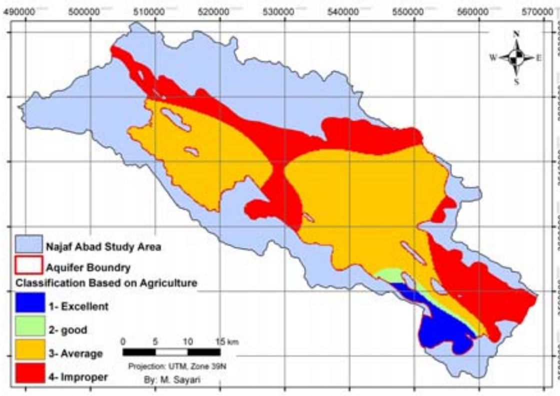

Figure (10): zoning of the study area in terms of agriculture based on SAR and EC

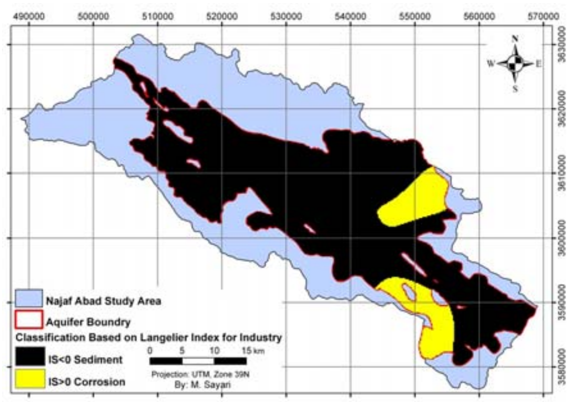

Figure (11): zoning of the study area in terms of industry based on Langelier index

Table 6: Classification of groundwater in the study area based on industrial applications

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Water quality	PHs-PH	PH	PHs	Coefficient C	Ca (mg/l)	Based on alkalinity CaO	Symbols
Sediment	-0/4	7/1	6/7	11/32	180	273/29	W1
Sediment	-0/7	7/5	6/8	11/32	141	218/345	W2
Sediment	-0/65	7/55	6/9	11/32	69	374/5	W3
Corrosion	0/25	7/25	7/5	11/3	89	66/545	W5
Sediment	-0/85	7/35	6/5	11/33	194	312/65	W9
Corrosion	0/1	7/3	4/7	11/31	97	82/04	W10
Sediment	-0/1	7/6	7/5	11/3	55	125/74	W11
Sediment	-2/05	7/15	5/1	11/36	1064	1558/35	W12
Sediment	-0/05	7/65	7/6	11/3	67	71/69	W14

IV. Conclusion and Recommendation

The present study aimed to determine the quality and quantity of groundwater in the basin of Najaf Abad in Isfahan in both present and future. As the quantitative results showed, the groundwater level declined 1.28 meter per year from 1995 to 2012. Uncontrolled exploitation of groundwater resources in the basin led to hydraulic and hydro chemical imbalance. According to this study, the quality of groundwater in most spots of the region was within average to acceptable limits. In total, 53.33% of the samples were average while 26.6% were unfavorable, 13.3% were acceptable and 6.6% were non-drinkable. Piper diagram showed that dominant cations of the basin were respectively as Na + K> Ca> Mg while the dominant anions were respectively as HCO3> Cl> SO4. Therefore, hydro chemical profile of groundwater resources in the range was carbonate type with sodic profile. However, several samples showed mixed Na-Ca-HCO3-Cl. According to Wilcox Diagram, 6.66% of the samples are suitable for agricultural purposes. .Qualitative studies conducted in industrial sector showed that 80% of the wells tend to sediment and 20% are willing to corrosion.

Considering that well No.12 (Shargh Ply Akril) is polluted in terms of quality compared to other wells, further sampling is recommended for future research in this area to clarify the issue.

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REFERENCES

[1] *Bahrain, G, r. Safavi, H,r. Saberi, A, r. 1386. Modeling the river to aquifer influx of Najaf Abad, Third National Congress on Civil Engineering.*

[2] *Greenberg AE, 1995. Clesceri LS, Eaton AD. Standard method for the examination of water and wastewater. 19th ed Washington: APHA.*

[3] *Jamshidzadeh,Z. Mirbagheri,S,A,2011, Evaluation of groundwater quantity and quality in the Kashan Basin, Central Iran, Contents lists available at cienceDirect,Desalination 270.23-30.*

[4] *Kalantari,N., N.J.,Pawar, M. R.,Keshavarzi .2009. Water resource management in the intermountain Izeh plain, southwest of Iran. Journal of mountain science, Vol. 6, No. 1, 25-41.*

[5] *5. Malakotian M, Karami A. 2004, Trend of chemical quality of groundwater resources and Browat Bam Plains.Hormozgan Medical Journal 8(2): 109-16. [In Persian].*

[6] *ground water monitoring, 2nd ed. USA: Taylor and Francis group; CRC Press.*

[7] *Meftah Helghi M. 2007, Research and pollutant sources of groundwater resources and provide guidelines to protect groundwater quality in the area of Qare Soo. Gorgan: Company Golestan Regional Water. p. 140-3. [In Persian].*

[8] *Quevauviller,P. 2009. Groundwater monitoring. USA: John Wiley & Sons.*

[9] *Raghunath, H.M , 1990, Groundwater, Wiley Eastern Limited, New Delhi, p. 563.*

[10] *Sally, H., Murray-Rust, H., Mamanpuosh, A.R., and Akbari, M. 2001, "Water supply and demand in four major irrigation systems in the zayandeh rud basin, Iran", Iranian Agricultural Engineering Research Institute, research report no.8.*

[11] *Thirumalini,S,Kurian,J. 2009, Correlation between electrical conductivity and total dissolved solid in natural waters, Malays. J. Sci. 28 (1) 55–61.*

[12] *Todd,D.K , L.W.,Mays .2005. Groundwater hydrology, 3nd, John wiley and sons publishers, p 636.*

[13] *United States Salinity Laboratory (USSL), 1954. Diagnosis and improvement of saline and alkali soils, USDA Hand Book, 60-147.*

[14] *Wang , C, H .Hsu, K, C.. Chen, K, C.Chen ,C, T. Ma , K,W.2007.Climate induced hydrologicalimpacts on the groundwater system of the Pingtung Plain , Taiwan. Hydrogeology Journal. 5; 903-913.*

[15] *WHO. 1993. Guidelines for drinking water quality. Volume 1: Surveillance and control of community supplies, 2nd edn. Geneva, Switzerland: World Health Organization.*

[16] *Yidana,S,M,.2010.Groundwater classification using multivariate statistical methods: Southern Ghana. Journal of African Earth Sciences 57:455–469.*

[17] *Zhang, B . Song, X. Zhang, Y. Han, D . Tang, Ch.Yilei Yu. Ma, Y. 2012, Hydrochemical characteristics and water quality assessment of surface water and groundwater in Songnen plain, Northeast China, International Journalof Water Research, Volume 46, Issue 8, Pages 2737–2748.*