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Content

Design And Construct Of An Anti hemorrhage Device For The Dialysis Patients Needling After Hemodialysis

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Abstract
Needling is one of the challenges that dialysis patients are facing with, for which selection of an appropriate method and speed of work is of high importance. At the end of dialysis process, when nurse begins withdrawal of the needle, she/he has to be careful so that the blood vessel in puncture site may not bleed. The work has to be done with speed and care. Correct performance of the procedure is of great help to patients, and also nurses working in dialysis ward. This may result in feasible stoppage of bleeding, and prevention of probable infections. The study aims at design and manufacture of a device to stop bleeding after withdrawal of needle from hand of dialysis patients, after the end of hemodialysis process. As you may know, after needle removal, the injection site has to be pressed for a certain time period (about 15 minutes) with a pressure more than blood pressure inside the vessel so that bleeding would be stopped, and not continued upon removal of pad. The process is currently done by patients themselves, persons accompanying them, or nurses. To make the process mechanized, we are intended to make a device. This way, time and quality of the procedure will be improved; and, safety against infection probability would be assured. In introduction section, an overview of the research importance and history has been made. In the research method section, an introduction has been made to the method applied, and its advantages. Eventually, analytical results have been discussed in conclusion section, in details.

Keywords: Needling ,Hemodialysis , Dialysis Pateints , Antihemorrhagic

1- Introduction

Hemodialysis is one of the most prevailing treatments for kidney failure of those patients in need of short term dialysis [1]. Hemodialysis involves various types of vascular access made through *arteriovenous grafts*, central venous catheter, *external arteriovenous shunt*, and/or *arteriovenous fistula* [2]. Here, central venous catheters are used; however, as far as they are considered as centers for stenosis, infection or thrombosis, an anteriovenous graft or fistula is better for long term usage [3]. Using various types of vasular access depends on the patients conditions. As shown by a report, permanent vascular access methods are used for 7 and 93% of cases, respectively to start hemodialysis and for temporary methods [4]; and, they are mainly replaced with permanent methods during treatment process. Anteriovenous fistula is one of the most appropriate and prevailing methods of vascular access in these patients; because it may be used for longer periods of time and has less side effects. In those patients with no suitable vessels for usage of aneriovenous fistula, anteriovenous graft or central venous catheter is used [3]. Each of vascular access methods has its own various side effects; so, certain measures have to be taken to increase persistence [5]. Vascular access complications have been the reason for 16 to 25% of hospitalizations in hemodialysis patients [6]. Van loon et al. have reported some complications such as hematoma, thrombosis, infection and aneurysm resulted from repeated injections in the same area of the blood vessel, which in turn increases hospitalization rate, and losing vascular access in patients [7]. For the same reason, venipuncture has not to be performed on any point of venous aneurysm [8]. According to Holland et al., having access to a successful hemodialysis program proper performance of vascular access area, and maintaining vascular accesses requires cooperation of physicians, surgeons, nurses and patients. However, he has mainly put emphasis on importance of monitoring vascular accesses through Doppler ultrasound as a method of controlling quality of the method of care and also its performance; while, role of nursing care in maintaining quality and efficiency of vascular accesses has been ignored by him. Also, Bachelda et al. have studied factors having effect on prevention of infection and its treatment in patients with anteriovenous grafts; and, Alexander et al. have studied behavior of physicians and those providing health care to hemodialysis patients. Accordingly, the way nurses behave towards sites of vascular access has been since ignored [11, 9, and 10]. In one of the rare cases of studies performed on quality of behavior in terms of site of vascular access, Van loon has studied those factors affecting cannulation, and complications resulted there from in patients with anteriovenous fistula. He has reported effect of improving venipuncture technique on persistence and performance of anterial fistula [7]. Some of previous studies also have emphasized the relationship existing between persistence, efficiency, and complications resulted from fistula and record of diabetes, record of central venous catheter, record of hypertension, age and gender [4, 6]. So, a device to stop bleeding from puncture site is of certain importance, after the end of hemodialysis process in patients. In this respect, various methods have been reviewed clinically in the research, so that best of them could be selected. The process has to be done with care and speed. Commonly, nurse removes the needle and asks the patient to press the bleeding site for 10 to 15 minutes, till it would be stopped. The method is very troublesome and sometimes patient or his/her companion goes out of patience. On the other hand, because of heparin existing in blood of dialysis patients, blood coagulation process takes place slowly. In continuation, the method used in the research will be introduced.

2- Research Method

The research aims at design and manufacture of an antihemorrhagic device so that it could be put in needling process of patients, after hemodialysis process. According to clinical results obtained, there is a significant relationship between quality of dialysis after hemodialysis, and the needling method. The device designed and manufactured is fully capable of automatically stopping bleeding, after needle removal. It has to be applied easily. It has to be applied with ease and speed. It has to be capable of being disinfected to eliminate human error in the process, to create high satisfaction in patients, and to make feasible the procedure of bleeding stoppage. The device could be used in various emergency conditions and locations, and/or it may be used as an alternative for previous methods. Considering studies and various circuits put into try and error, following block diagram has been achieved for such device.

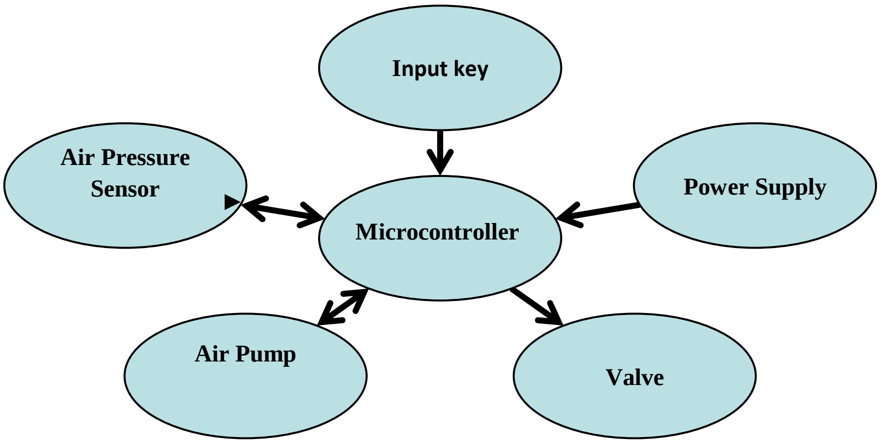

Figure 1- Block diagram of device design

After completion of circuit design, it was implemented on Bread-Board to be put to different tests. The results have been indicative of proper performance of the circuit, designed to be used in needling process. In respect of designing digital circuit, micro ATmega16 has been used as computation center, data storage, and sender of data to computer. After final design of the circuit, designing the printed circuit board (PCB) was performed to integrate all parts by AltiumDesigner software. After completion of design of PCB, all parts such as board, air cuff, serial port, on-off and date sending switches, and converter of urban alternating current to direct current have been placed on it. Final diagram of the device could be observed in figure (2).

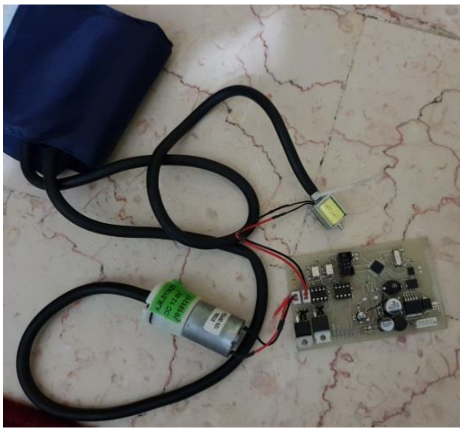

Figure 2- A diagram of the device

3- Clinical tests

To test accuracy of the antihemorrhagic device, manufactured device has been applied on dialysis patients, after the process. That is, at the end of hemodialysis process which nurse begins removal of the needle, the device capable of stopping the afterward bleeding may impose certain pressure on puncture site, from which blood has been removed from the patient body. This is of considerable help to those nurses working in dialysis ward. The device could be used for patients with different ages and weights. This is a light weight device with simple application. Satisfaction level of patients experiencing both old method and the device is shown in the following figures.

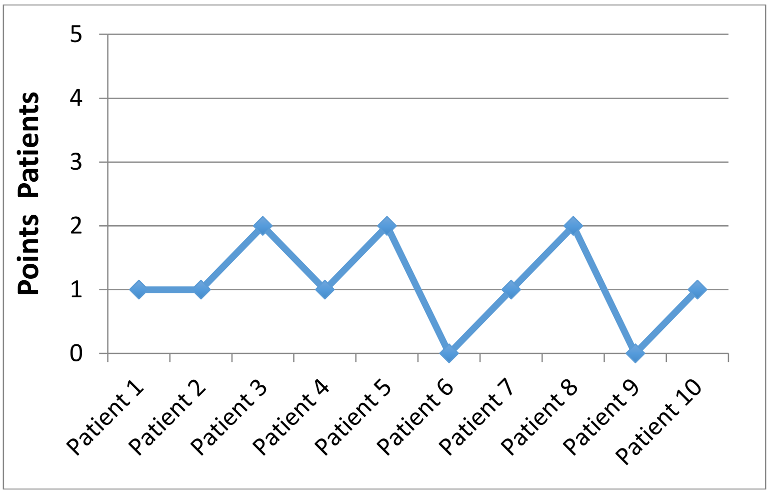

Figure 3- Satisfaction level of dialysis patients before using the device (five scores)

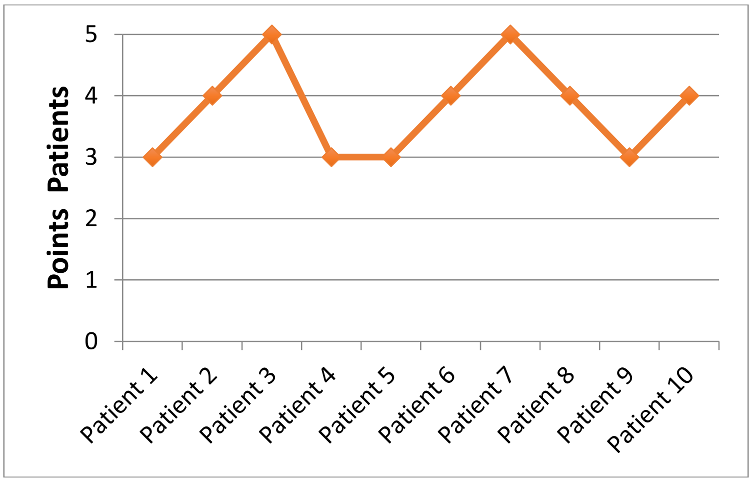

Figure 4- Satisfaction level of dialysis patients after using the device (five scores)

4- Conclusion

Considering necessity of antihemorrhagic device for dialysis patients and lack of such device in Iran and also around the world; design and manufacture of such device during the study was decided upon. In this respect, such device has been designed to stop bleeding after removal of needle from patients' hands, after the end of hemodialysis process. The results indicated that the manufactured device is of numerous advantages including: lack of noise acceptance, high accuracy, being first instance of manufacturing technology in the world, imposing adjustable pressure on puncture site, making bleeding stoppage feasible, capable of being added to hemodialysis device, being portable, easily applicable, being fully mechanized, capable of being used in various emergency conditions and locations, preventing transfer of probable infections, capable of being mass produced, cost efficiency, and finally capable of increasing quality of dialysis.

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An application of fuzzy TOPSIS method in recognizing and prioritizing of competitive strategies (Case Study: Cement Industry)

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Abstract
Strategy is a comprehensive program that determines main approaches of the organization and suggests proper ways for allocating resources in order to help the organization to achieve its long term objectives. Environment changing, competitiveness, customer expectations for quality products and efficiency of manpower, have convinced the attitude of managers to have an organizational strategic program. So Strategic Management can play an important role in the decision making and crucial activities with determining long term activities in each organization. Strategic Management process is made from three stages: Strategy formulation, strategy implementation and evaluation that in the strategy formulation, internal and external parts of the organization can be a proper way to provide competitive strategies in an organization. In this article Topsis is used as one of the multi-criteria decision making techniques in the Fuzzy environment to rank the proposed competitive strategies, finally a numerical example is taken to explain the Fuzzy Topsis method. As a result, the prioritized competitive strategies respectively are shown, Value Strategy, Market Development Strategy, Concentric Related Diversification Strategy, Energy Resources Development Strategy and Product Development Strategy.

Keywords: multi criteria decision making techniques, Topsis, Competitive strategies

1. Introduction
Decision making in today's changing and uncertainty conditions has made it difficult for organization's managers to make decisions. It's clear that managers need tools to help them assess their relative position to the competitors and environment and strategic management provides the ability to make the best decisions with the best allocation of resources with a long-term vision.[1] Strategic management has been widely used by all enterprises to withstand fierce market competition.[7] As a first step in the development of a strategic planning system, the business managers should therefore commence with the identification and evaluation of these strategic factors which assist or hinder the company in reaching it's full potential. Because every company is confronted with a dynamic environment, the relative importance of a strategic factor

will change constantly, so this analysis is accordingly to be of a permanent nature. Good performances in a company are the results of correct interaction of business management with it's environment. This environment can be of either an internal or external nature. [9] SWOT analysis is a commonly used for analyzing internal and external environments in order to attain a systematic approach and support for decision making. SWOT analysis is a useful tool for strategic planning in environmental management, and provides the basic foundation for identifying the situation and designing future procedures which is necessary in strategic attitude.[11,25,16] SWOT is an acronym for Strengths, weakness, opportunities and threats.[22]

Strengths: In this part the organization strengths are determined. The organization’s strength should be determined realistically by the internal and external customer’s assistance.

Weaknesses: Determining weaknesses is important both in internal aspect and customer’s view. Accepting the weakness is difficult for the organizations.

Opportunities: Opportunities are those factors which could determine the organization’s development in the market. Factors which could affect opportunities include technology changes, government policies and social patterns.

Threats: Although organizations don’t like threats, they always have to face them because of uncontrollable external factors. It is vital for an organization to prepare to face the threats in a chaotic environment.[20]

However, for the first time in the literature, Hill and Westbrook (1997) and Kurttila, Pesonen, Kangas, and Kajanus (2000) suggested that SWOT analysis, although widely used in the strategic planning process and provides the key factors of the problem, it has some drawbacks in selecting appropriate strategy for the evaluation and final decision steps.[22,6] that 4 of them are listed by Hill and Westbrook:

1. Usually only qualitative examination of environmental factors is considered;
2. It considers no priority for various factors and strategies;
3. If the number of factors are more, the number of adopted strategies will be increased exponentially (for example if the number of each set of factors of S, W, O, T is equal to 5, the resulting number of the combined strategies will be around 100 which would make the selection of the appropriate strategy very difficult);
4. It does not consider the vagueness of the factors.[11] With analyzing of mentioned factors can identify those that may impact on the outcomes future of the organization or institution. Pattern of strengths, weaknesses, opportunities and threats for the recognition of the unique competencies of the organization is critical success factors of an organization. The purpose of factors analysis, provides strategies that guarantees a balance between internal and external environments.[2]

Literature review of conventional SWOT analysis reveals that the importance of the criteria is not quantified to provide the effect of each criterion on the proposed strategy. As planning processes are often complicated and difficult by numerous criteria, it may be utilization of SWOT is insufficient. In other words, SWOT analysis cannot provide an analytical means to attain performance ratings and weights of each SWOT factor, hence, SWOT analysis has not the ability to assess the appropriateness of decision alternatives based on these factors. While it does pinpoint the factors in the analysis, individual criteria are usually expressed briefly and very generally. Therefore, SWOT analysis cannot comprehensively assess the strategic decision-making process.[12]

Fuzzy set theory is a powerful tool for quantity show and overcoming some of the challenges arising from uncertainty in the decision-making processes. In a considered values or parameters that are not sufficiently accurate, fuzzy set with fuzzy numbers can be considered. Triangular and trapezoidal fuzzy numbers are common representations in this area.[3]

Therefore, in this study, fuzzy approach is used to analyze, then attempted to define the main factors situation analysis and prioritization of proposed strategies in Tehran Cement Company and subsequently provide appropriate solutions to improve the company's position in the internal and external environment..

2. Literature Review

"Strategy" is a Greek word from "stretego" which consists of "stratos" and "ego" meaning "army" and "leadership" respectively. Strategic planning started as "general art" but is now known as "top manager's art". It could be claimed that strategic planning in general and the SWOT analysis in particular, have their mutual origins in the work of business policy academics at Harvard Business School and other American business schools from the 1960s onwards. The work of Kenneth Andrews has been especially influential in popularizing the idea that good strategy means ensuring a fit between the external situation a firm faces (threats and opportunities) and its own internal qualities or characteristics (strengths and weaknesses). Manufacturing strategy can be seen as reflecting this idea of fit in functional terms. There have, of course, been other subsequent approaches to strategy formation which urge different thinking, most importantly the work of Porter. Yet this SWOT-type analysis of internal and external assessment and seeking a fit between the two perspectives has remained popular.[10]

In many cases SWOT analysis is a strategic planning method and can be used in conjunction with other tools for audit and analysis of an involved venture. It's originated from is "SOFT" (Satisfactory, Opportunity, Fault and Threat) and came from the research conducted during 1960–1970. The SOFT analysis was presented in a seminar at Zurich in 1964, Urick and Orr changed the F to a W and called it the SWOT. Weihrich modified SWOT (or TOWS) into the format of a matrix, matching the internal factors (i.e. the strengths and weaknesses) of an organisation with its external factors (i.e. the opportunities and threats) to systematically generate responses that ought to be undertaken by the organisation.[8] Weihrich's article introduces SWOT matrix as a tool for situation analysis.[11] Porter (1990), in RBV view emphasizes a facility's internal strengths and weaknesses in contrast to industrial organization economics, thus focuses on a firm's external opportunities and threats.[15] Ozcan and Deha (2008) examined the application of SWOT analysis to formulate strategies that are related to the safe carriage of bulk liquid chemicals in maritime tankers.[23]

Today, research focuses on multi-stage analysis including three elements: SWOT, MCDM, and Fuzzy sets theory, so we mentioned following studies:

Kurttila et al. (2000) integrated SWOT analysis with specific techniques to show how to calculate SWOT group and factor weights quantitatively in a uni-directional hierarchical structure by AHP technique to a forest certification case. Chang and Huang (2006) also suggested the quantified SWOT analytical method which was adapted to the concept of Multiple-Attribute Decision Making. They used AHP and a multi-layer scheme to simplify complicated problems. Yu¨ksel and Dagˇdeviren (2007) performed SWOT analysis using the analytical network process (ANP) to determine the most suitable strategies for a textile firm. [17,13]

Ghazinoory, Zadeh & Memariani (2007) also used the fuzzy theory concept to examine the SWOT analysis in an Iranian food corporation. In their study, the optimal strategy area was determined based on internal and external factors.[22] Zaerpour et al. suggested an innovative hybrid methodology consisting of SWOT analysis and Fuzzy Analytic Hierarchy Process (FAHP).[8] Kahraman1 (2008) proposed a method to evaluate different alternative strategies for e-government applications in Turkey. They used the SWOT in conjunction with the analytic hierarchy process (AHP) to prioritize their strategies.[23] Lee et al. (2009) utilized quantitative SWOT analytical method to locate the competitive relation of global logistics hub.[13] Also Celik et al. (2009) used the elements in the following way: he applied axiomatic design and TOPSIS methodologies under fuzzy environment for proposing competitive strategies.[8] Saati and Hatami-Marbini(2009), studied on SWOT analysis with using Topsis method.[12]

Lu (2010) showed the applicability of SWOT analysis within the context of maximum sub array and fuzzy set theory in a study of an international construction company.[22] Morteza Shafiee and Khodaparasti (2011) studied Research titled "Iranian Bank Strategic Methodizing Based On FBSQ Model (A Combined Model of BSC , Fuzzy SWOT and Fuzzy QFD Techniques).[20] Tahernejad et al. (2011) used SWOT–AHP (Analytic hierarchy process) approach to define dimensional stone mines decision process in a hierarchical structure of factors. He then quantified the relative importance of each factor to the decision and determined the priorities of the strategies for these mines.[13]

Ghorbani and Velayati (2011) have conducted a study titled Using Fuzzy TOPSIS to Determine Strategy Priorities by SWOT Analysis.[13] Nikzad Manteghia and Abazar Zohrabib have done A proposed comprehensive framework for formulating strategy: a Hybrid of balanced scorecard, SWOT analysis, porter`s generic strategies and Fuzzy quality function deployment.[16] Mehdi Mohammad Pur and Akbar Alem Tabriz(2012) did a study in Petrokaran Film Company as New SWOT Analysis on top of the Fuzzy HOQ.[14] Mazaher Ghorbani, Mahdi Bahrami and Mohammad Arabzadeh have conducted a study as " An Integrated Model For Supplier Selection and Order Allocation; Using Shannon Entropy, SWOT and Linear Programming".[17]

3. Method

In increasingly competitive global market, multiple-criteria decision making (MCDM) has found acceptance in areas of management science, the discipline has created many methodologies. Especially in the last years, the applications of MCDM methods are extended because computer usage has increased considerably. [12] Decision-making process is finding the best situation from the present choices. Almost in all decision-making problems, the decision-maker confronts difficulties because of frequency criteria. That is, the decision-maker, while implementing a variety of choices wishes to reach more than one target. [24]

An MCDM problem with m alternatives and n criteria can be concisely expressed in matrix format as follows. The conventional MCDM is a kind of MCDM problems, which the ratings and the weights of criteria are measured in crisp numbers. The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), a family of classical MCDM technique, is a popular approach and has been widely used in the literature. [12]

Hwang and Yoon 1981 were first suggested classic TOPSIS method. TOPSIS method is based on the idea that the most preferred alternative should be the shortest distance from the ideal solution and the longest distance from the anti-ideal solution. Note that the ideal solution is a solution that maximizes the benefit criteria and minimizes the cost criteria, whereas the anti-ideal solution maximizes the cost criteria and minimizes the benefit criteria. In real situations, these ratings and weights are usually difficult to be judged very precisely because of the existence of uncertainty and vagueness, but can be suitably characterized by linguistic terms which are fuzzy in nature and then set into fuzzy numbers. [12] Fuzzy sets and fuzzy algorithms proposed by Zadeh have been applied to various fields such as automata theory, control system and pattern classification. This paper is concerned with an application of the fuzzy sets concept to rank-ordering or choice behavior. [19] Such a method was extensively extended by many practitioners to deal with fuzzy MCDM problems. [12]

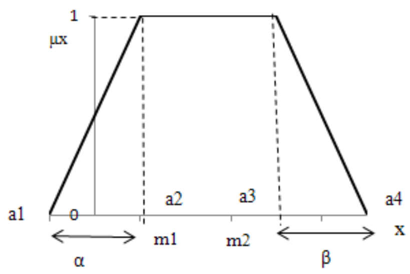
Before describing the method, let us describe the Fuzzy numbers:

If in definition of the fuzzy number, single-exponential features can be eliminated, then it is called a fuzzy interval. In other words, there is an interval in the state during this period; the membership function is equal to one. With this definition, the fuzzy number is a special case of a fuzzy interval. Interval fuzzy, also called trapezoidal fuzzy number.[4] Assume that all linguistic terms can be represented with triangular fuzzy numbers, and that these fuzzy numbers are limited in the interval. Thus these performance ratings would be not normalized.[12]

The rates of all decision-makers with fuzzy trapezoidal fuzzy numbers are assumed to be positive. A trapezoidal fuzzy number A or in short form trapezoidal is shown =(m1,m2,α,β) , that is defined in

R as follow:

$$\mu_{A(x)} = \begin{cases} \dfrac{x-a_1}{b_1-a_1} & a_1 \le x \le b_1 \\ 1 & b_1 \le x \le b_2 \\ \dfrac{x-a_2}{b_2-a_2} & b_2 \le x \le a_2 \\ 0 & \text{Other Wise} \end{cases} \qquad [5] \qquad (1)$$



1-3) fuzzy numbers to diffuzified numbers:

Sometimes it is necessary to compare two fuzzy numbers, to determine which one is bigger than the other. Sometimes, due to the large variations and extensive calculations of fuzzy numbers, we need to make them deterministic, that is called "Diffuzification".[4]

The most important methods of diffuzification are: average method, α -cut method, center of area method.

-Average: This method is represented by "Lee and Li" that is based on average and standard deviation. It is illustrating for trapezoidal fuzzy as follow:

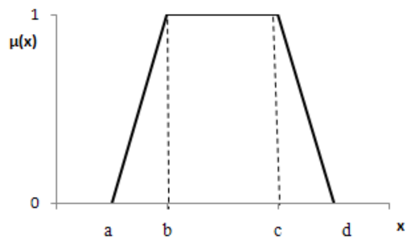


Fig2)Trapezoidal Fuzzy Numbers

$$\overline{X}(\mathrm{M}) = \frac{(-\mathrm{a}^2 - \mathrm{b}^2 + \mathrm{c}^2 + \mathrm{d}^2 - \mathrm{ab} + \mathrm{cd})}{[3(-\mathrm{a} - \mathrm{b} + \mathrm{c} + \mathrm{d})]} \tag{2}$$

$$\sigma(M) = \left\{ \frac{\left[\frac{1}{b-a}\left(\frac{b^4}{4} - \frac{ab^4}{3} + \frac{a^4}{12}\right) + \frac{1}{3}(c^3 - b^3) + \frac{1}{d-c}\left(\frac{d^4}{12} - \frac{dc^3}{3} + \frac{c^4}{4}\right)\right]}{\left[\frac{1}{2}(-a-b+c+d)\right]} - \{(-a^2 - b^2 + c^2 + d^2 - ab + cd)/[3(-a-b+c+d)]\}^2 \right\} \tag{3}$$

In comparison with two fuzzy numbers, the average of each fuzzy number is greater, the larger. In case of equality of mean, standard deviation is least, the larger fuzzy number is.[4]

2-3) The steps of Fuzzy Topsis Technique:

First Step: Select the appropriate linguistic variables for the importance weight of index terms and rates for the linguistic strategies

In many decision making situations under uncertainty, because of the complexity and uncertainty of objective things, and the ambiguity of human thinking, decision making information given by decision makers, often takes the form of linguistic variables. In the process of decision making, how to aggregate or deal with this given linguistic information by using a proper aggregation operator or mathematical model becomes a key step. [18] In this study, weights and rates of functional vocabulary are evaluated. To convert linguistic terms to fuzzy numbers, there are different scales. Chen and Huang (1994) have proposed different measures of different number of linguistic words and fuzzy numbers. In order to introduce a different scale, simply select one of the shapes in terms of the number of words that are used by decision makers. [4]

These linguistic ratings, employed by specialists to represent the fuzzy performances under certain criteria, are very good (VG), good (G), medium good (MG), fair (F), medium poor (MP), poor (P) and very poor (VP). The linguistic weights for presenting the importance of criteria are very high (VH), high (H), medium high (MH), medium (M), medium low (ML), low (L) and very low (VL). [12]

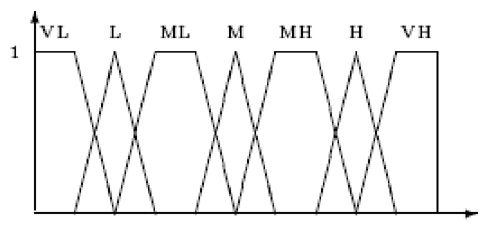


Chart2) importance of linguistic weights

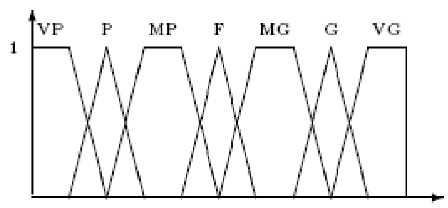


Chart1)The linguistic variables for rating

More over decision maker suggestion have been shown from linguistic variables by considering different criteria in chart 1, 2 for determining weights of criteria and linguistic terms.

Second Step: Create a fuzzy decision matrix and normalized fuzzy decision matrix

Suppose that an expert team has K decision-makers conversant with the operations and missions of the organization and it can be denoted by E_k. Let C_j be a set of n criteria, called

SWOT sub-factors, which affect the prosperity of the organization but may be managed by the organization, are identified. Finally, suppose Ai be a set of m alternative strategies that are obtained according to mission of organization and SWOT sub-factors. [12]

Let a set of performance ratings of Ai (i = 1, 2, . . . , m) regarding to criteria Cj (j =1, 2, . . . , n) denoted by X = {(xij , | i = 1, 2, . . . , m, j = 1, 2, . . . , n, }.

$$D = \begin{array}{c} A_1 \\ \vdots \\ A_i \\ \vdots \\ A_m \end{array} \begin{bmatrix} c_1 & c_2 & \dots & c_n \\ x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & & x_{2n} \\ \vdots & & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad , \quad W = (W_1, W_2, \dots, W_n)$$

Then comments of decision makers defined by fuzzy numbers, determined by the formula to convert diffuzified numbers into a matrix D: [12]

When the data are considered from matrix D, different views of the same column are compared with different rows. To simply assessment of different options, require D matrix to standard with formula (3), and the matrix R can be converted into a single rij.[21]

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x^2{}_{ij}}} \qquad [4]$$

$$R = \begin{bmatrix} \widetilde{r_{11}} & \widetilde{r_{12}} & \dots & \widetilde{r_{1n}} \\ \widetilde{r_{21}} & \widetilde{r_{22}} & & \widetilde{r_{2n}} \\ \vdots & & \ddots & \vdots \\ \widetilde{r_{m1}} & \widetilde{r_{m2}} & \cdots & \widetilde{r_{mn}} \end{bmatrix} \quad , \quad \widetilde{W} = (\widetilde{W_1}, \widetilde{W_2}, \dots, \widetilde{W_n})$$

Third step: Create the weighted normalized decision matrix

R matrix is the foundation of our future assessment. At this stage, we weighted the matrix R:

$$V = R.W \qquad (5)$$

Fourth Step: Determine the fuzzy positive ideal solution and fuzzy anti-ideal solution

In this step we specify ideal solution and anti- ideal solution:
The ideal alternative is shown by X^*:

$$X^* = \{(\mathrm{Max_i r_{ij}} | \mathrm{j} \in \mathrm{J}), (\mathrm{Min_i r_{ij}} | \mathrm{j} \in \mathrm{J'}) | \mathrm{i} \in \mathrm{M}\} = [\mathrm{r^*}_1, \mathrm{r^*}_2, \dots, \mathrm{r^*}_\mathrm{n}] \qquad (6)$$

And also the anti-ideal alternative is shown by X^- as below:

$$X^- = \{(\mathrm{Min_i r_{ij}} | \mathrm{j} \in \mathrm{J}), (\mathrm{Max_i r_{ij}} | \mathrm{j} \in \mathrm{J'}) | \mathrm{i} \in \mathrm{M}\} = [\mathrm{r^-}_1, \mathrm{r^-}_2, \dots, \mathrm{r^-}_\mathrm{n}] \qquad (7)$$

To determine the ideal and the anti-ideal alternatives, depending on the index, type of the process is different. In formula (6) and (7), M is the set of alternatives, and J, J' are strengths, weaknesses, the opportunities and threats. Strengths and weaknesses are part of the positive, opportunities and threats and negative indicators.

Fifth Step: Calculate each alternative from the positive and anti-ideal alternative options

At this stage, the distance of each alternative can be computed from the ideal as follows:

$$S^{*}_{i} = \sqrt{\sum_{j=1}^{n} (r_{ij} - r^{*}_{j})^{2}} \qquad (i \in M) \tag{8}$$

Then, the distance of each alternative can be computed from the anti-ideal as follows:[21]

$$S^{-}_{i} = \sqrt{\sum_{j=1}^{n} (r_{ij} - r^{-}_{j})^{2}} \qquad (i \in M) \tag{9}$$

Sixth step: Calculate the closeness coefficient of each strategy

Finally, the degree of closeness of each alternative from the ideal item is calculated by the following formula:

$$C_{i} = \frac{S^{-}_{i}}{(S^{-}_{i} + S^{+}_{i})} \tag{10}$$

Seventh Step: Prioritizing of Competitive Strategy

Based on above the more degree of each strategy, the better.[21]

3.3 Numerical Example of Fuzzy TOPSIS prioritize competitive strategies

In this section, the TOPSIS technique will be reviewed for SWOT analysis and prioritization of competitive strategies in Tehran Cement Company. To obtain the proposed strategy to compete with rivals, a three-number team of experts (DM_1,DM_2,DM_3) , 13 number of indicators are considered from sub-indicators of the organization's internal and external factors, (C_1,C_2,….C_n) and using a SWOT matrix, according to experts and decision makers fifth strategy is shown in the table below:

internal factors		external factors	
Strengths	**weaknesses**	**opportunities**	**threats**
1) High variability in the production of cement C_1	1) Lack of capacity to cover demand C_4	1)competitors geographical distance away from the main centers of Tehran cement consumption of cement C_8	1) Commissioning of new companies by competitors C_{11}
2) Near the metropolis as a vast market C_2	2) High cost sack packing C_5	2)Cement export opportunities for Tehran to export to Central Asia, especially Turkmenistan C_9	2) Aging through foreign partners to invest in neighboring countries C_{12}
3) Suitable for Transportation Management Systems C_3	3) Old machinery and equipment C_6 4) Shortage of railroad loading C_7	3)Lime stone mining exploration in other areas C_{10}	3) Lack of shipping tonnage Top C_{13}

And proposed strategies are:

1. Value Strategy
2. Market Development Strategy
3. Concentric Related Diversification Strategy
4. Energy Resources Development Strategy
5. Product Development Strategy

The relative weights of the linguistic words or indicators specified such as: Very Low, Low, Medium Low, Medium, Medium High ,High, and Very High. As it showed in chart (1) the fuzzy numbers diffuzified with formula 2.

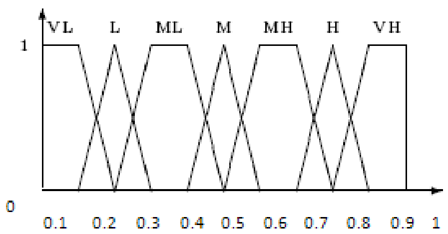


Chart4) importance of linguistic weights

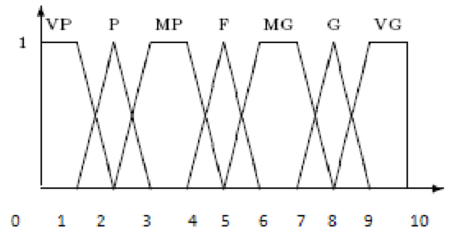


Chart3)The linguistic variables for rating

Table1)linguistic to identify indicators importance

Linguistic terms	Trapezoidal Fuzzy	Diffuzified fuzzy numbers
(VL)	(0,0,0.1,0.2)	0.077
(L)	(0.1,0.2,0.2,0.3)	0.116
(ML)	(0.2,0.3,0.4,0.5)	0.35
(M)	(0.4,0.5,0.5,0.6)	0.5
(MH)	(0.5,0.6,0.7,0.8)	0.65
(H)	(0.7,0.8,0.8,0.9)	0.8
(VH)	(0.8,0.9,0.9,1)	0.9

The index value associated with strategies also with linguistic terms such as:

Very Good, Good, Medium Good, Medium, Medium Poor, Poor, Very Poor that are defined in table2.

Table2)linguistic terms for strategies importance

Linguistic terms	Trapezoidal Fuzzy	Diffuzified fuzzy numbers
(VG)	(0,0, 1, 2)	0.77
(G)	(1, 2, 2, 3)	2
(MG)	(2, 3, 4, 5)	3.5
(F)	(4, 5, 5, 6)	5
(MP)	(5, 6, 7, 8)	6.5
(P)	(7, 8, 8, 9)	8
(VP)	(8, 9, 9,10)	9

Three expert decision makers, are represented their opinions regarding the importance of the 13 independent parameters that are shown in Table 3.

Table3)the importance of weights of 13 indicators regarding to decision makers

indicators	DM_1	DM_2	DM_3	Diffuzified fuzzy numbers
C_1	H	MH	H	0.75
C_2	H	H	VH	0.83
C_3	MH	MH	MH	0.65
C_4	M	MH	M	0.55
C_5	MH	M	VL	0.409
C_6	VH	MH	MH	0.73
C_7	MH	VL	L	0.281
C_8	H	MH	H	0.75
C_9	MH	ML	VH	0.63
C_{10}	M	ML	L	0.322
C_{11}	H	H	H	0.8
C_{12}	MH	L	M	0.422
C_{13}	M	L	M	0.372

The following table reviews the decision and the performance of each strategy that is determined by indicators:

Table4)prioritizing the 5 strategies with 13 indicators by 3 decision makers

indicators	Strategy alternatives	DM_1	DM_2	DM_3	Diffuzified fuzzy numbers
C_1	VS	G	G	F	3
	MD	MG	MG	G	3
	CRD	VG	G	VG	1.18
	ED	F	MG	P	5.5
	PD	G	MG	F	3.5
C_2	VS	G	MG	G	2.5
	MD	F	F	VG	3.59
	CRD	F	MG	MG	4
	ED	F	F	F	5
	PD	F	F	MG	4.5
C_3	VS	G	MG	VG	2.09
	MD	G	F	G	3
	CRD	F	F	P	6
	ED	F	F	P	6
	PD	MG		G	1.83
C_4	VS	MG	G	F	3.5
	MD	MG	G	G	2.5
	CRD	F	G	P	5
	ED	F	MG	P	5.5
	PD	G	G	P	4
C_5	VS	G	F	VG	2.59
	MD	F	F	P	6
	CRD	F	F	P	6
	ED	F	F	P	6
	PD	G	F	MP	4.5
C_6	VS	G	MG	P	4.5
	MD	MG	MG	MG	3.5
	CRD	MG	MG	MG	3.5
	ED	G	MG	VG	2.09
	PD	MG	MG	G	3

indicators	Strategy alternatives	DM1	DM2	DM3	Diffuzified fuzzy numbers
C7	VS	G	MP	MP	5
	MD	MG	MP	F	5
	CRD	MG	MP	P	6
	ED	F	MP	P	6.5
	PD	MG	MP	P	6
C8	VS	G	MG	G	2.5
	MD	MG	MG	VG	2.59
	CRD	MG	G	G	2.5
	ED	F	F	P	6
	PD	MG	MG	G	3
C9	VS	G	F	MG	3.5
	MD	G	MG	VG	2.09
	CRD	F	F	VG	3.59
	ED	F	F	MP	5.5
	PD	MG	F	G	3.5
C10	VS	G	F	P	5
	MD	F	F	P	6
	CRD	MG	F	P	5.5
	ED	F	F	P	6
	PD	MG	F	P	5.5
C11	VS	G	F	MP	4.5
	MD	MG	MG	VG	2.59
	CRD	MG	MP	G	4
	ED	F	F	P	6
	PD	MG	MP	F	5
C12	VS	G	MG	G	2.5
	MD	G	MG	VG	2.09
	CRD	F	F	G	4
	ED	F	F	F	5
	PD	MG	MP	G	4
C13	VS	G	MP	P	5.5
	MD	F	MP	G	3.83
	CRD	MG	MP	F	5
	ED	MG	MP	P	6
	PD	MG	MP	P	5

Then we write the calculated diffuzified numbers (by formula (2)) from the indicators table as Weight Matrix and calculated diffuzified numbers from the decision makers table, as decision matrix (Table 5).

$$D = \begin{bmatrix} \widetilde{x_{11}} & \cdots & \widetilde{x_{113}} \\ \vdots & \ddots & \vdots \\ \widetilde{x_{51}} & \cdots & \widetilde{x_{513}} \end{bmatrix}_{5\times 13}$$

$$\widetilde{W} = (\mathbf{0.75}, \mathbf{0.83}, \mathbf{0.65}, \mathbf{0.55}, \mathbf{0.409}, \mathbf{0.73}, \mathbf{0.281}, \mathbf{0.75}, \mathbf{0.63}, \mathbf{0.322}, \mathbf{0.8}, \mathbf{0.422}, \mathbf{0.372})$$

Next, the Euclidean method (formula (4)), we diffuzified the matrix D and call matrix as R (Table 6).

Then with formula (5), we normalize diffuzified matrix, and call it V matrix.(table7)

Due to the nature of the indicators, the ideal and the anti-ideal solution can be identified. (Formula (5,6)).

$$\mathbf{X}^* = \begin{Bmatrix} 0.524, 0.463, 0.414, 0.15, 0.091, 0.2, 0.11, 0.561, 0.408, 0.154, 0.203, \\ 0.127, 0.125 \end{Bmatrix}$$

$$\boldsymbol{X}^- = \begin{Bmatrix} 0.11, 0.231, 0.13, 0.32, 0.211, 0.4307, 0.142, 0.234, 0.155, 0.128, 0.47 \\ , 0.257, 0.193 \end{Bmatrix}$$

According to formulas (8) and (9) we calculate the distance of each alternative. For example, we obtain the distance to the first alternative (First Strategy) from the ideal and the anti-ideal:

$$\boldsymbol{S}^*\text{vs} = \sqrt[2]{\begin{matrix}(0.286-0.524)^2 + (0231-0.463)^2 + (0.144-0.414)^2 \\ + \cdots + (0.179-0.125)^2\end{matrix}}$$

$$\boldsymbol{S}^-\text{vs} = \sqrt[2]{\begin{matrix}(0.286-0.11)^2 + (0231-0.231)^2 + (0.144-0.13)^2 \\ + \cdots + (0.179-0.193)^2\end{matrix}}$$

Distance from each of strategies form the ideals is:

Table8)Distance from each of strategies form the ideals

strategies	**VS**	**MD**	**CRD**	**ED**	**PD**
$\boldsymbol{S}^*$	0.906	0.899	0.143	1.011	0.833

Distance from each of strategies form the anti-ideals is:

Table9)Distance from each of strategies form the anti-ideals

strategies	**VS**	**MD**	**CRD**	**ED**	**PD**
$\boldsymbol{S}^-$	0.661	0.695	0.858	1.075	0.701

In the last step, using the formula number (10), we calculate the degree of closeness of each option:

Table10)calculation the degree of closeness of each strategies

strategies	degree of closeness
VS	0.422
MD	0.436
CRD	0.857
ED	0.515
PD	0.457

As noted above, the higher the degree of each strategy has the better.

So, we represent the prioritizing the proposed competitive advantages as follow:

$$\text{CRD} > \text{ED} > PD > \text{MD} > \text{VS}$$

Table11) ranking of strategies

strategies	ranking
VS	5
MD	4
CRD	1
ED	2
PD	3

In this case, the fuzzy and imprecise weights and rates, expressed in Fuzzy TOPSIS Technique have been used for prioritizing strategies. Thus, organizations are able to make more appropriate decisions as strategic decisions.

4) Conclusion:

In terms of strategic management, the company's long-term sustainability depends on competitiveness mission and vision. When competitiveness is possible, the company acts along with strategies that has determined according to the resources and capabilities and its opportunities and threats. Strategic activities which have no strategic coherence or are inconsistent with those are preset strategies or activities do not support these strategies, lead to irrational use of resources. Thus, decisions based on strategies and priorities have a great importance for the company. In this study, SWOT as a common tool in strategic planning and TOPSIS technique as multi attribute decision making method have been used for selecting and prioritization of appropriate competitive strategy. The selection of these methods has two reasons: **First**, SWOT analysis cannot quantitatively determine the weight and impact of strategic factors on strategies**. Second**, the choosing the method in a competitive environment often is associated with vague and uncertain data. in this paper, strategy of SWOT analysis have been evaluated in fuzzy environment.

In other words, evaluation of possible strategies has been mentioned instead of numerical measurements by using linguistic variables (according to criteria and importance of the weights). Therefore, TOPSIS has been developed for fuzzy's data and is an algorithm to determine the most preferred strategy among all possible strategies (when the data are fuzzy). Fuzzy decision making matrix is weighted and normalized. In this approach, the distance of every strategy from ideal and anti-ideal solutions is calculated by using the concept of ranking fuzzy numbers. Finally, closeness coefficient is defined to achieve ranking for all strategies. In fact, this method is very simple and flexible. At the end, the result of prioritization of these strategies is as below:

Competitive Strategies	ranking
Concentric Related Diversification Strategy	1
Energy Resources Development Strategy	2
Product Development Strategy	3
Market Development Strategy	4
Value Strategy	5

As mentioned, strategies are important in all aspects and used in different situations of the organizations but by prioritizing, managers will be sure about their strategies, so they can more easily adopt rational strategic decisions.

Also because of resource consuming strategy and the company's resources limitation, so it is need to prioritize selection of strategy. As a result of Fuzzy Topsis method, for implementation of this strategy, in *Tehran Cement Company* Managers should provide comprehensive and coordinated plan by paying attention to the organizational goals. In this strategy, the company is entering to a new industry that can used from its technical knowledge and production capabilities and market skills. Respectively the other strategies mentioned as: Energy Resources Development Strategy, Product Development Strategy, Market Development Strategy, and Value Strategy.

For future studies, group decision making by more decision makers can be used. Therefore it is expected that the presented suggestion in this paper will have been more managerial applications for future research.

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Table5)prioritized matrix from 5 strategies with 13 indicators by 3 decision makers-diffuzified

C_i / A_i	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
VS	3	2.5	2.09	3.5	2.59	4.5	5	2.5	3.5	5	4.5	2.5	5.5
MD	3	3.59	3	2.5	6	3.5	5	2.59	2.09	6	2.59	2.09	3.83
CRD	1.18	4	6	5	6	3.5	6	2.5	3.59	5.5	4	4	5
ED	5.5	5	6	5.5	6	2.09	6.5	6	5.5	6	6	5	6
PD	3.5	4.5	1.83	4	4.5	3	6	3	3.5	5.5	5	4	5

Table6) diffuzified decision matrix

Ci / Ai	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
VS	0.381	0.278	0.222	0.369	0.223	0.59	0.39	0.312	0.412	0.398	0.441	0.3	0.48
MD	0.381	0.4	0.312	0.264	0.516	0.459	0.39	0.323	0.246	0.478	0.254	0.25	0.335
CRD	0.15	0.446	0.637	0.528	0.516	0.459	0.468	0.312	0.423	0.438	0.392	0.49	0.437
ED	0.699	0.558	0.637	0.581	0.516	0.274	0.507	0.748	0.648	0.478	0.588	0.61	0.52
PD	0.445	0.502	0.194	0.421	0.387	0.393	0.468	0.374	0.412	0.438	0.490	0.48	0.437

Table7)weighted difuzified matrix

Ci / Ai	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}
VS	0.286	0.231	0.144	0.203	0.091	0.4307	0.11	0.234	0.26	0.128	0.353	0.127	0.179
MD	0.286	0.332	0.203	0.15	0.211	0.335	0.11	0.242	0.155	0.154	0.203	0.106	0.125
CRD	0.11	0.370	0.414	0.29	0.211	0.335	0.132	0.234	0.266	0.141	0.314	0.207	0.163
ED	0.524	0.463	0.414	0.32	0.211	0.2	0.142	0.561	0.408	0.154	0.47	0.257	0.193
PD	0.334	0.417	0.13	0.232	0.158	0.287	0.132	0.281	0.26	0.141	0.392	0.203	0.163

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Optimal sitting and sizing of DG for loss reduction and improve voltage profile based on Genetic Algorithm

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Abstract
Distributed Generation (DG) is a promising solution to many power system problems such as voltage regulation, power loss and etc. This paper presents a method for the optimal sitting and sizing of Distributed Generation in distribution systems. In this paper, our aim would be optimal Distributed Generation sitting and sizing for voltage profile improvement and loss reduction in distribution network. Genetic Algorithm (GA) was used as the solving tool, which referring two determined aim. The problem is defined and objective function is introduced. We used MATPOWER package for load flow algorithm and composed it with our Genetic Algorithm. The suggested method is programmed under MATLAB software.

Key words: Distributed Generation (DG), Genetic Algorithm (GA), Voltage profile, Optimal sitting

1. Introduction
Distributed power generation is a small-scale power generation technology that provides electric power at a site closer to customers than the central generating stations. Distributed generation (DG) provides a multitude of services to utilities and consumers, including standby generation, peaks chopping capability, base load generation. Investments in DG enhance on site efficiency and provide environmental benefits, particularly in combined heat and power applications. Before installing distributed generation, its effects on voltage profile, line losses, short circuit current, amounts of injected harmonic and reliability must be evaluated separately. Since the installation of DG units at non-optimal places can result in an increase in system losses, implying in an increase in costs and, therefore, having an effect opposite to the desired. For that reason, the use of an optimization method capable of indicating the best solution for a given distribution network can be very useful for the system planning engineer.

The selection of the best places for installation and the preferable size of the DG units in large distribution systems is a complex combinatorial optimization problem. The optimal placement and sizing of generation units on the distribution network has been continuously studied in order to achieve different aims. The objective can be the minimization of the active losses of the feeder [1,2], or the minimization of the total network supply costs, which includes generators operation and losses compensation [3-6], or even the best utilization of the available generation capacity [7]. In this paper is presented an algorithm for the allocation of generators in distribution networks, in order to voltage profile improvement and loss reduction in distribution network. The Genetic Algorithm is used as the optimization technique. In Section 2 it is presented a brief discussion about distributed generation issues and Section 3 is an introduction to the Genetic Algorithm. The problem formulation is presented in Section 4 and the proposed solution method is discussed in Section 5. It is presented an application example in Section 6 and finally, the conclusions.

2. Distributed Generation

DG can be defined as a small-scale generating unit located close to the load being served. A wide variety of DG technologies and types exists: renewable energy source such as wind turbines, photovoltaic, micro-turbines, fuel cells, and storage energy devices such as batteries. Both the distribution company and/or the customer can, in principle, invest in and operate units. Due to the availability of such a flexible option of DG as an energy source at the distribution voltage level, the distribution network is now being transformed from a passive network to an active one. The DG as an energy source in the distribution network will play a significant role in operation, structure, design and up gradation issues. DG technologies, their benefits and concepts, and their valuable effect on the electricity market make it a credible alternative in the distribution system planning. The importance of DG is now being increasingly accepted and realize by power engineers. From distribution system planning point of view, DG is a feasible alternative for new capacity especially in the competitive electricity market environment and has immense benefit such as [2,3]:

- Short lead-time and low investment risk since it is built in modules.
- Small-capacity modules that can track load variation more closely.
- Small physical size that can be installed at load centers and does not need government approval or search for utility territory and land availability.
- Existence of a vast range of DG technologies.

For these reasons, the first signs of a possible technological change are beginning to arise on the international scene, which could involve in the future the presence of a consistently generation produced with small and medium size plants directly connected to the distribution network (LV and MV) and characterized by good efficiencies and low emissions. This will create new problems and probably the need of new tools and managing these systems.

3. Genetic Algorithm

Genetic Algorithm is a family of computational models that rely on the concepts of evolutionary processes. It is a well known fact that according to the laws of natural selection, in the course of several generations, only those individuals better adapted to environment will manage to survive and to pass on their genes to succeeding generation.

Correspondingly, the GAs operate on a set (population) of possible solutions (individuals) of a generic problem, applying selection and reproduction criteria where by new solutions are generated containing the information enclosed in the solution from which they originated. Clearly, the better solution, the more possibilities there are of reproducing and passing on genes to the offspring.

The first step to be taken in implementing these algorithms is to encode a potential solution in a simple data structure of the chromosomal type in which each element is represented by means of a specific alphabet (usually binary). Once the initial population has been randomly generated, every solution is evaluated by means of objective function.

The strategy followed by GAs is very simple. To ensure amelioration in the population, in each generation a selection operator sees to it that the solution with higher fitness have greater possibilities of reproducing. At this point some individuals are coupled and cross-bred by means of a crossover operator, which recombines the salient information brought by the parent structure in a significantly non–destructive way. The crossover operator produces offspring that will then replace some of the old individuals of the population. Lastly, the strings can undergo mutation, which involves selecting, with little probability, a string element and changing the symbol contained therein with another symbol of the alphabet being used (Figure 1).

Once the procedures performed by three operators have been completed, the offspring produced are evaluated and compared with their parents. If the GA is generational, then the offspring will replace their parent only if they are better.

Several parameters normally influence the search for the optimum solution by GAs such as population size, the probability of mutation the maximum number of generations to be explored and etc. These parameters should be accurately calibrated, adapting them to the size of the problem in question.

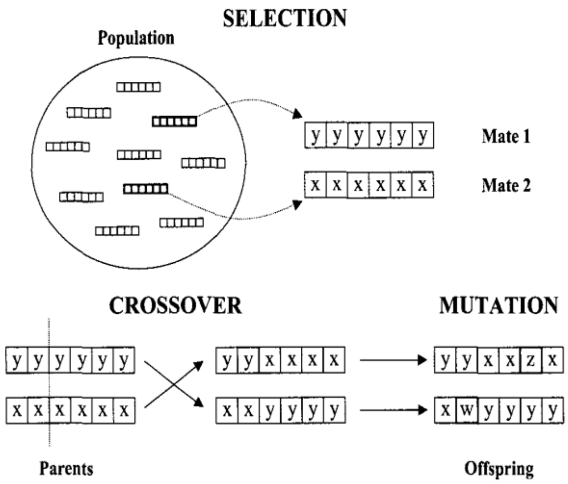

Figure 1: GA operators

4. Problem Formulation

Problem is determining of optimal size and place for DG unit installation for reduction of loss and improves of voltage profile.

For reach to this aim, two constraints should be noticed:

1. Losses before installing DG in power grid should be less than losses after installing of it.

$Loss\ with\ DG\ \leq\ Loss\ without\ DG$

$f1 = k1 \sum_{i=1}^{n}(p_i\ without\ DG - p_i\ \ with\ DG) \geq 0$

$f2 = k2 \sum_{i=1}^{n}(Q_i\ without\ DG -\ Q_i\ with\ DG) \geq 0$

2. Voltage magnitude of bus should be improve in this voltage constraint.

$V\ bus\ min \leq V\ bus \leq V\ bus\ max$

$f3 = k3/m \sum_{i=1}^{m}(\ v\%_i\ with\ DG - v\%_i\ without\ DG) \geq 0$

Finally objective function is:

$F = \max f1 + \max f2 + \max f3$

In this expression *f1* and *f2* are the difference of active and reactive power losses and *f3* related to difference between average of voltage profile percentage in base case and other cases according to DG's locations.

Mentioned parameters are listed below:

$p_i\ without\ DG$: Active Power Losses in j^{th} branch without DG resource.

$p_i\ with\ DG$: Active Power Losses in j^{th} branch with DG resource.

$Q_i\ without\ DG$: Reactive Power Losses in j^{th} branch without DG resource.

Q_i $with$ DG: : Reactive Power Losses in j^{th} branch with DG resource.
$v\%_i$ $without$ DG: Voltage Percent in i^{th} bus without DG resource.
$v\%_i$ $with$ DG: Voltage Percent in i^{th} bus with DG resource.
$k1, k2, k4$: Emphasis or penalty factors.
m: Number of Buses.
n: Number of Branches.

5. Proposed Algorithm

In this paper we use Genetic Algorithm for find best size and installation point to reach reduction of loss and voltage improve, in addition this object optimization problem could contain another aim like cost of system, network upgrading investment and etc.

6. Case study

Proposed algorithm is tested in a 16 node sample network that showed in figure 4. In this paper maximum quantity of DG unit 2 assumed, process of algorithm are commented below. To adjust proposed formula with GA, valid coding of potential solution is required firstly. In this paper a chromosome with 16 gens was used that this chromosome setup with binary case of possible size and sitting point.

Y1 and Y2 are gens of sizing and X1 and X2 are gens of first and second DG unit sitting point. After use this encoding and use proposed algorithm for this sample network 4MW and 4MW for size and 8 and 13 for sitting point are obtained.

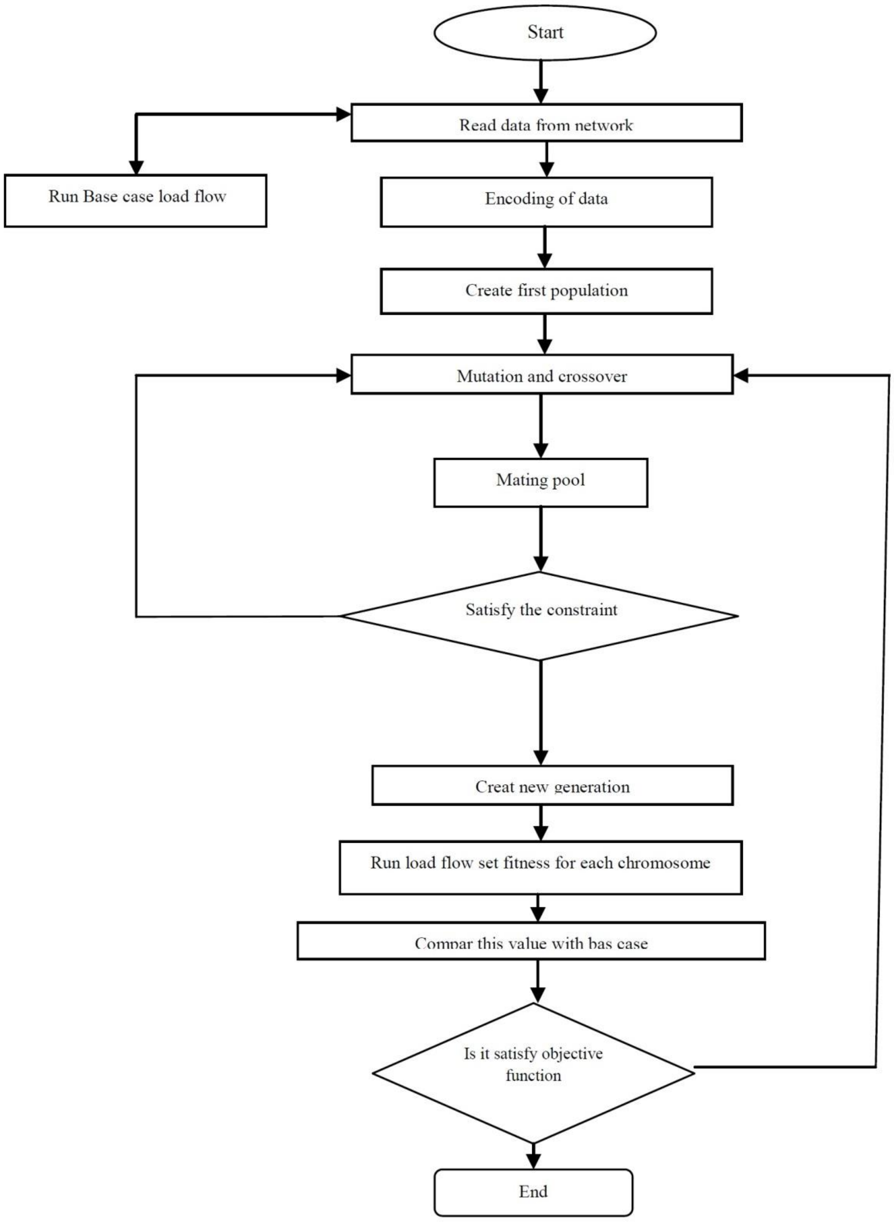

Figure 2: Flowchart of algorithm

Y1	Y1	Y1	Y1	Y2	Y2	Y2	Y2	X1	X1	X1	X1	X2	X2	X2	X2

Figure 3: Gens String

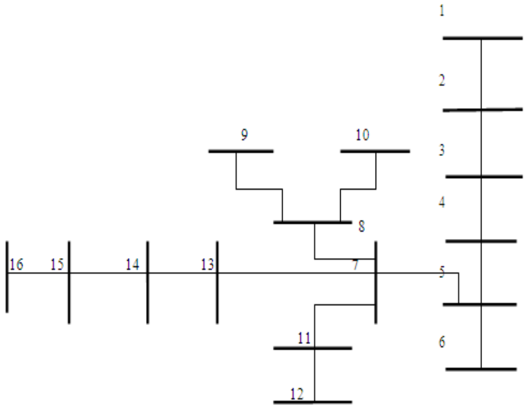

Figure 4: 16 node sample network

Table 1: Line information

Line Characteristics			
From	**To**	**R(Ohm)**	**X**
1	2	0.176	0.138
2	3	0.176	0.138
3	4	0.045	0.035
4	5	0.089	0.069
5	6	0.045	0.035
5	7	0.116	0.091
7	8	0.073	0.073
8	9	0.074	0.058
8	10	0.093	0.093
7	11	0.063	0.05
11	12	0.068	0.053
7	13	0.062	0.053
13	14	0.05	0.04
14	15	0.08	0.03
15	16	0.035	0.03

Table 2: Bus information

Bus Characteristics		
Bus Number	**P (kW)**	**Q (kVAR)**
1	0	0
2	890	468
3	628	470
4	1112	764
5	636	378
6	474	344
7	1342	1078
8	920	292
9	766	498
10	662	480
11	690	186
12	1292	554
13	1124	480
14	780	345
15	650	200
16	400	350

Results of Algorithm response are showed in Figure 5, 6 and 7.

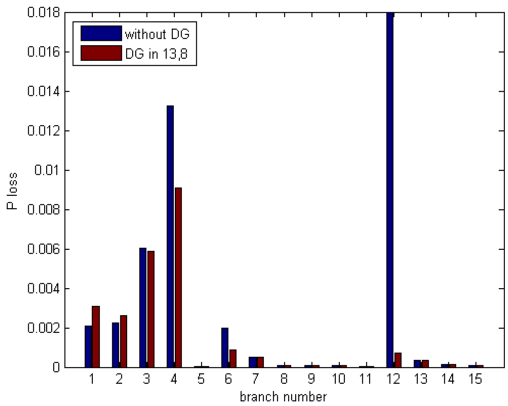

Figure 5: Active power loss

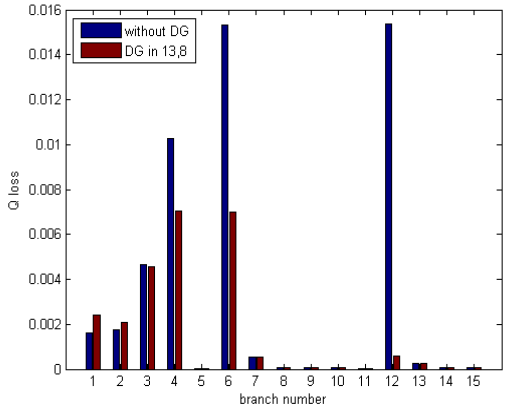

Figure 6: Reactive power loss

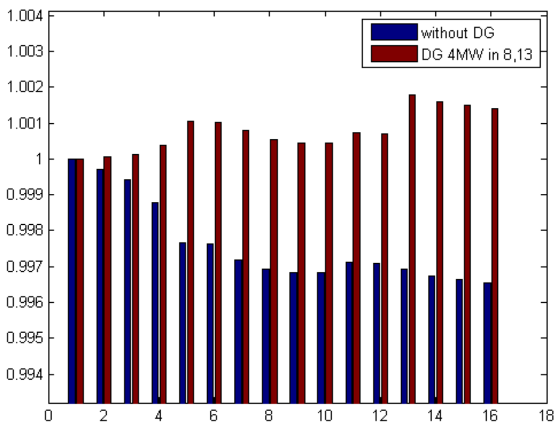

Figure 7: Voltage profile

7. Conclusion

In this paper the results of application of GA algorithm to he optimal allocation of DGs in distribution network is presented. The effectiveness of the proposed algorithm to solve the DG allocation problem is demonstrated through a numerical example. The Khoda Bande Loo distribution test feeder in Tehran has been solved with the proposed algorithm and, the simple genetic algorithm.

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Heavy metal removal from drilling fluid wastes: An Overview

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Abstract
Liquid drilling fluid is often called drilling mud is heavy, viscous fluid mixture use to carry rock cuttings to the surface and lubricate and cool the drill bit. During carrying cutting they contaminated which not only reduced their functionality but also make them a hazardous and dangerous wastes which cannot be discharged anywhere without treatment. Due to this fact, in the presents study, a brief account of recent developments and technical applicability of different treatment methods for heavy metal removal is reviewed with a particular focus on nanomaterial adsorbent for the drilling wastes treatment methods for heavy metal removal is reviewed with a particular focus on nanomaterial adsorbent for the drilling wastes treatment in oil and gas industry and include a case study in the region of azadegan formation. The challenges that face future trends of nanomaterial applications in the oil and gas drilling industry are also discussed.

Keyword: Drilling fluid, Nanomaterial, Adsorbent

1. Introduction
Crude oil and natural gas are fossil fuels that come from dead animals and plants which have been covered by layers of sedimentary rock, and heated under pressure in the absence of sir over millions of years. Crude oil is obtained from the earth crust and since oil and gas less dense than water, they rise to the top of porous rock layers. They may then become trapped below a layer of non-porous rock and the trapped gas or oil can only be obtained by drilling through the non-porous layer. Oil exploration, drilling, and extraction are the first phase or what the oil industry call the “upstream” phase in the long life cycle of oil [1].

The physical alteration of the environment from exploration, drilling, extraction, drilling, and extraction activities include deforestation, ecosystem destruction, chemical contamination of land and water, long-term harm to animal populations and human health amongst others. Oil exploration, drilling, and extraction activities involve the use of water-based muds(WBMs), oil-based muds(OBMs) and synthetic-based muds(SBMs) to:

- Cool and clean the bit
- Maintain pressure balance between the geological formation and the borehole
- Lubricate the bit
- Reduce friction in the borehole
- Seal permeable formations
- Stabilize the borehole and;
- Carry cuttings to the surface for disposal[2]

Water-based muds(WBMs) are by far the most commonly used mud, both onshore and offshore. They are widely used in shallow wells and shallower portions of deeper well, but are not very effective in deeper wells. The use of WBMs sometimes generate 7000 to 13000 bbl of waste per well and about 1400 to 2800bbl of that amount are drill cuttings depending on the depth and diameter of the well. WBMs use water as their base fluid and do not contain any oil, but are economical and easy to dispose of because of their relative biodegrability and low toxicity [3]. However, due to some limitations of WBMs, oil-based muds(OBMs) have been developed to overcome the problems associated with WBMs and are effective for a wide range of special situations, which include high temperatures, hydratable shales, high angle and extended-reach well, high density mud and drilling trough to salt. Lower waste volume is produced from well drilled with OBMs, this is due to the fact that very little slumping or caving in of the walls of the hole can occur. Similarly, OBMs can be reconditioned and reused rather than been discharged at the end of the well and it is only the drilling cuttings that will be disposed to the ocean. The average volume of OBM waste is estimated at 2000 to 8000 bbl per well as compared to WBMs [3].OBMs use either diesel or mineral oil as the base fluid and since they contain oil, their waste cannot be discharged on site without camplying drilling mud(drilling wastes) are sometimes unintentionally or intentionally released into water bodies and can damage the gill of prawn, shrimp and other bottom dwellers at post larvae stages. For most aquatic animals, the gills are major sites through which waterborne pollutants can enter the body and are often effected by such substances [4,5,6,7]. The toxic effect could be due to the paraformaldehyde biocides and heavy metal included in the different mud formulations/ composition, which increases the toxicity to aquatic species especially bottom dwelles [8,9]. Acute (short-term) and chronic (long-term) health impacts can occur through bioaccumulation of oil, metal and other products in aquatic species that are consumed by humans.

This paper first presents the different technique for the removal of heavy metals for waste fluid and the potential solutions the nanotechnology may offer. Next a case study of nanomaterial as adsorbent is perented for the removal Pb(II) ions. To conclude, the challenges of nanotechnology application in oil and gas drilling industry are highlighted.

2. Drilling fluids and health risk management

Drilling fluids are used extensively in the upstream oil and gas industry, and are critical to ensuring a safe and productive oil or gas well. During drilling, a large volume of drilling fluid is circulated in an open or semi enclosed system, at elevated temperatures, with agitation, providing a significant potential for chemical exposure and subsequent health effects. When deciding on the type of drilling fluid system to use, operator well planners need to conduct comprehensive risk assessments of drilling fluid systems, considering health aspects in addition to environmental and safety aspects, and strike an appropriate balance between their potentially employers whose workers may become exposed to the drilling fluid system.

Some adverse health effects associated with drilling muds are:

- Irritation of the skin, eyes or alimentary mucosa caused by either low pH mud, surfactant or nuisance dust (dearomatized hydrocarbons can enhance irritancy).
- Secondary irritation when proloned and repeated contact (base oils/ solvents) with skin will remove natural fats and oil to cause redness, drying and cracking.
- Respiratory irritation primarily
- Inhalation effects such as acute central nervous system(CNS) depression when working with hydrocarbon solvent
- Possible sensitization to biocides and finally.
- Possible carcinogenicity due to polycyclic aromatic hydrocarbons (PAH) and asbestos.

3. Existing technologies for heavy metal removal

Removal of heavy metals dissolved at low concentrations in water and wastewaters is often a problem that can be solved in different ways.

A number of approaches have been developed or suggested for the treatment of industrial effluents in order to meet mandatory discharge standards. The most commonly used techniques are precipitation, adsorption, ion exchange, reverse osmosis, and ion flotation. The methods vary considerably in cost and effectiveness. A brief overview of these existing technologies is given here.

3-1. Precipitation

Many dissolved solids precipitate from water to form scale as the temperature, pressure, and/or chemistry changes[10]. Precipitation is a well-known process capable of removing heavy metals from aqueous solution. For example, by the addition of sodium hydroxide or lime, the solution pH is raised to a regime exceeding the solubility of metal hydroxides, causing the precipitation of metal hydroxides an large quantities of metals from contaminated water and is extensively used in industry because d lowering the concentration of metal ions in solution. This method is effective for the removal of its simplicity. The problems associated with precipitation process are slow solid–liquid separation, low density of solids, and the ultimate disposal of the voluminous sludge which often contains a high content of water. The inappropriate disposal of unstable precipitates may cause secondary contamination of water because metal ions can be leached out from the sludge, returning to the aqueous environment. In addition, a polishing step is required for most precipitation processes in order to achieve low residual levels of metal ions in the processed water. Furthermore, precipitation is a costly method without the offset of producing secondary resources. There are only a few metals that can precipitate to form a valuable solid product, such as gypsum for the construction industry [11]. Most forms of precipitation, however, leave residual levels of solids dissolved in solution. These residual levels may still exceed regulatory standards, and additional treatment of the water may be required [10].

3-2. Adsorption

Adsorption process is based on the adsorption of soluble contaminants in solution onto a solid adsorbent. The widely used material of adsorption is activated carbon though sandstone, fly ash, clay, and other surface reactive adsorbents are often used in wastewater treatment. This method is capable of removing most toxic species, including Cu^{2+}, Cr^{4+}, Pb^{2+}, Hg^{2+}, and Zn^{2+}. Since most adsorption processes are preformed in a column packed with adsorbents, prefiltration step is needed for most industrial applications in order to remove finely divided solids which may, otherwise, clog the channels available for transporting liquid. Regeneration of the adsorbent and the cost for carbon replacement are issues to be concerned with. In addition, the surface functionalization by solvent deposition and covalent attachment on ceramic supports as commonly used failed to demonstrate high ligand coverage and stability of the attached functional groups. These drawbacks can be overcome by applying the sol–gel processing method to form a silica network with functional ligands [11].

3-3. Ion Exchange

The ion-exchange process relies on the exchange of certain undesirable cations or anions in wastewater with sodium, hydrogen, chloride, etc., in porous polymer resins of either a styrene or an acrylic matrix. The removal of hardness ions is necessary for many processes because these ions readily precipitate and form a hard scale that can foul equipment. precipitate and form a hard scale that can foul equipment.

There are two major ion exchange resins (substrates) that are commonly used: strong acid resins, using sulfonic acid, and weak acid resins, using carboxylic acid[10]. The ion-exchange process continues until the solution being treated exhausts the resin exchange capacity. The exhausted resin must be regenerated by other chemicals which replace the ions captured in the ion-exchange operation, thus converting the resin back to its original composition for reuse in the next cycle. Many chelating resins have been reported but they do not show physical rigidity due to swelling of the polymeric skeleton, poor wettability, small surface area, poor selectivity, slow adsorption rate, and challenge in regeneration. Clogging and regeneration of resins, similar to that encountered in the adsorption process by activated carbon, may also be experienced in this approach. In practice, wastewater to be treated by ion exchange is generally pre-filtered to remove suspended solids which could mechanically clog the resin bed [11].

3-4. Reverse Osmosis

In industry, reverse osmosis removes minerals from boiler water at power plants. The water is boiled and condensed over and over again and must be as pure as possible to avoid fouling or corrosion of boilers. It is also used to clean effluent and brackish groundwater. The apparent limitations of this approach are concerns with membrane lifetime, loss in flux rate, relatively small amount of effluent that can be treated and limited types of materials that can be removed. Some solutions (strong oxidizing agents, solvents, and other organic compounds) can cause dissolution of the membrane materials. Fouling of membranes by suspended solids in wastewater is another concern. Pretreatment of effluents is thus necessary for reverse osmosis system [11]. This process concentrates the wastes, which results in a smaller waste volume that ultimately must be disposed. This process is also very expensive. Fouling is the most difficult problem to overcome when using reverse osmosis on oilfield brines. Pretreatment of the water prior to entering the reverse osmosis facility is required. Because of its high cost, reverse osmosis is most commonly used to provide a supply of pure water in arid areas, rather than as a treatment method for waste water. However, in areas where high-quality water is scarce, reverse osmosis can be used to treat produced water [10].

3-5. Ion Flotation

Ion flotation involves the removal of surface-inactive ions from aqueous solutions by the addition of surfactants capable of forming ion–surfactant pairs, and the subsequent passage of gas bubbles through the solutions. Due to the surface active nature of the surfactant, the ion–surfactant pairs are concentrated at the air/water interface of bubbles which float to the surface of the solution where they are removed as foams. In general, an ionic surfactant (known as collector in mineral processing) of opposite charge to the surface inactive contaminants is used to induce an electrostatic force between them, thus forming ion–collector pairs. However, it is possible to use a non-ionic surfactant capable of forming coordination bonds with contaminants as a collector. Ion flotation has been widely applied in base metal recovery, wastewater treatment, removal of radioactive elements from water, and the recovery of precious metals. The major advantage of ion flotation over activated carbon adsorption is that air bubbles are relatively inexpensive to produce and no desorption step is required. However, a stoichiometric ratio of surfactant molecules to ions to be removed is needed in ion flotation. Therefore, the process can be quite expensive and may only be used to float ions in solutions of low concentration.

In summary, each technique reviewed has its own limitations in industrial applications although they have been practiced to a varying degree. Low selectivity, complex to operate, high capital and energy costs, and slow separation kinetics are the commonly inherent shortcomings. In addition, it is also inefficient in treating waste streams that contain low concentrations of contaminants and may fail when handling wastes of complex chemistry. Because the active materials are difficult to regenerate, these processes generate significant amounts of secondary waste [11].

3-6. Nanotechnology Application in Metal Ion Adsorption

With the development of science and technology, the application of nanomaterials and nanotechnology in environmental pollution management has been intensively interesting in the last decade. Materials in the nanosized range are considered the best candidates in the removal of organic and inorganic pollutants from the environment because of their unique physicochemical properties [12] . Amultitude of factors have been attributed to the chemical reactivity enhancement of nanoparticles: small particle size leading to an increase in specific surface area, increase in the surface energies for easier delocalization of electrons and perfection in atomic organization in the lattice. Besides increased reactivity, the availability of different forms of nanomaterials (e.g., nano-oxides, nanometals, dendrimers, nanoclays, etc) and enhanced knowledge about nanoparticle incorporation on support structures has opened new avenues for science to thoroughly investigate the potential of nanotechnology for large scale environmental detoxification [13, 14].

In order to meet diverse requirements, many efforts have been made on the nano-engineering of particle surface to tune the bulk properties, tailor the surface properties (e. g. charge density, functionality, reactivity, biocompatibility, stability, and dispersibility), and create multi-functional composite nanoparticles [15] .

Magnetic nanocomposites with tailored surface functionalities have found a wide range of applications, including biological cell separation, waste remediation, gas purification, and raw material recovery from complex multiphase systems as shown in Fig. 1. The challenge to magnetic nanocomposite particles for these applications is to synthesize the particles of strong magnetic properties with high density of reactive functional groups, diversity of functionalities, and durability of surface films. Magnetic nano-adsorbents are composed of the magnetic cores and polymeric shells. Compared to the traditional adsorbents, they not only can be manipulated or recovered rapidly by an external magnetic field but also possess quite good performance owing to high efficient specific surface area and the absence of internal diffusion resistance. Fig. 2 schematically illustrates the mechanism of separation of metals from industrial effluents [11, 15, 16].

Magnetite nanoparticles are an exceptional adsorbent materials due to their magnetic properties and good adsorption capacity [17].

Loaded metal ions could be stripped off by acid washing. Since adsorption of metal ions on the magnetic nanoparticles is a reversible process, it is possible for regeneration or activation of the adsorbent to reuse. The primary objective of regeneration is to restore the adsorption capacity of exhausted adsorbent while the secondary objective is to recover valuable components present in the adsorbed phase, if any [14]. This desorption process was discussed in many studies and it was showed that magnetic nano-adsorbents could be used several times effectively [15,16,18,19]. Selective separation of different metal ions was achieved by controlling the solution pH [15].

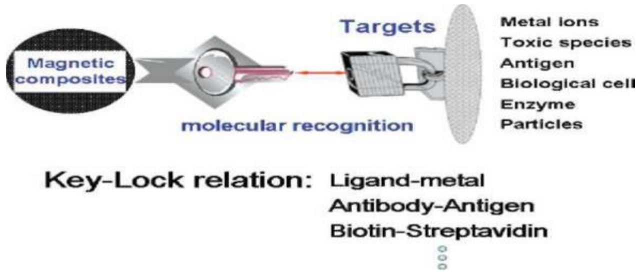

Fig.1. Key-lock relation in potential applications of magnetic composites particles [11]

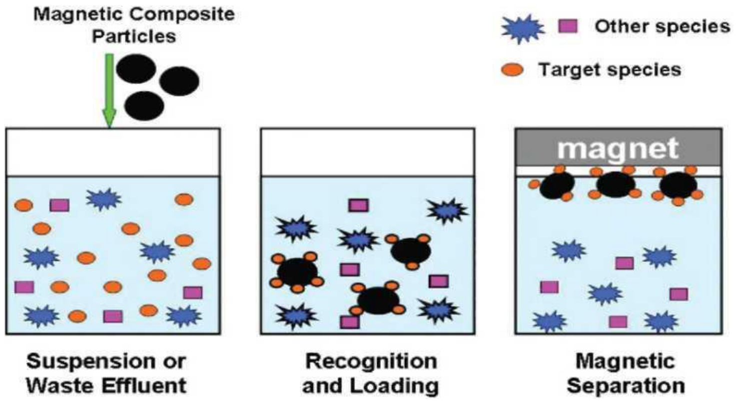

Fig.2. Illustration of magnetic separation technology in metal recovery from an industrial effluent [11]

4. Future challenges

Although many achievements with nanomaterial have been made in laboratory conditions, serious challenges remain in field implementation for oil industry environments.

Most nanomaterial-based products are still in the research and laboratory developmental stage in the oil industry. Before they can be practically applied, numerous problems need to be solved, such as the production of low cost and easily industrialized nanomaterials. Some of the barriers that may slow implementation of future development in nano systems for oil/gas sector include the following:

1. Lock of strong support for innovation in the petroleum industry.
2. Barriers to entry and adsorption
3. Perceived cost and risk
4. Lack of awareness

With continued heavy interest in nano technologies in the oil and gas industry , many potential solutions will emerge for the above referenced challenges. Once solutions to these problem are solved and relevant technologies developed, nano technologies can be extensively applied in just every area of the oil/gas industry.

5. Applied case study the removal of Pb(II) ions

The sample drilling fluid for test , made and used from azadegan formation. Azadegan well is located in the north of khozestan and produces an average of 20-25 thousand of oil per day. Properties of this sample explained in table 1. Results obtained show removal efficiency adsorption Pb (II) by nano particle Fe_3O_4 about is 85%[my project]. The nanomaterial adsorbent used in this study, showed that the adsorption rate was very quite fast and being simple to use and environmental-friendly.

Table 1.Opration drilling fluid properties.

Mud property,unit	Measured value
Mud system	WBM(1)
Mud weight, pcf	135
pH	9
YP(2)	19
PV(3).cp	34
Apparent Viscosity	15
Initial gel	2
10 min	3
Water less l/30min	1

(1)WBM:Water base mud,(2) YP:yield point,(3) PV:Plastic Viscosity

6. Conclusions

The present paper presented an overview of the most recent waste fluid treatment methods for heavy metal removal. Nanoparticles exhibit good adsorption efficiency especially due to higher surface area and greater active sizes for interaction with metallic species compared to the conventional methods. The case study showed that the efficiency of Pb(II) ions adsorption from drilling fluid wastes by magnetic nanoparticles is about 85%. The method could be effectively applied in oil drilling industry. This method has relatively high adsorption efficiency, scale-saving, being simple to use and environmental -friendly, and time and cost efficiency.

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Design And Construct Of An Anti hemorrhage Device For The Dialysis Patients Needling After Hemodialysis

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An application of fuzzy TOPSIS method in recognizing and prioritizing of competitive strategies (Case Study: Cement Industry)

Manizheh Mollaei, Ali Mohaghar, Mehdi Afzalian

Optimal sitting and sizing of DG for loss reduction and improve voltage profile based on Genetic Algorithm

Saeid Jalilzadeh1, Shahriar Golchin

Heavy metal removal from drilling fluid wastes: An Overview

Nasrin Changizabasi1,, Nader Nabhani

پژوهش های نوین علوم مهندسی

۰۲۱ ۴۳ ۸۵ ۷۱ ۲۴
۰۲۶ ۳۲ ۷۴ ۷۱ ۵۸

۰۲۱ ۳۳ ۲۰ ۲۴ ۸۷
۰۲۶ ۳۲ ۷۲ ۴۷ ۸۷

تهران: افسریه، ۱۵متری چهارم، کوچه ۳۸، پلاک ۲۸، واحد ۲

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