Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2012, 4(12):5180-5184

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Defluoridation of water by precipitation

Djamel Atia and Abdelghani HOGGUI

Laboratoire de Valorisation et Technologie des Ressources Sahariennes Département Sciences de la Matière, Institut des Sciences et Technologie Centre Universitaire Ouargla B.P. 1040 El-Oued 39001, ALGERIA

ABSTRACT

El-Oued is known for some diseases caused by fluoride concentration in drinkable water. To reduce it ,we have chosen a sample with the biggest content of fluoride among many sources in order to precipitate it with $CaCl_2$. After that studying the parameters influencing (mass , pH, temperature) to chose the best conditions in order to get better reduction yield.

Keywords: fluorine, fluorosis, defluoridation, Water, El-Oued, precipitation

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INTRODUCTION

The concentration of fluoride in groundwater depends on the geological characteristics, and chemical properties of rocks and climate of the region. Fluoride content in the groundwater of the major classes of northern Algerian desert often exceed World Health Organization standards, which indicated that the consumption of high fluoride water for long periods causes health complications from discolored teeth to fluoride poisoning Bone. When concentration between (0.5-1.5 mg / l),it gives good protection against tooth decay; and if it exceeds 1.5 mg / l, defect occurs in tooth enamel but at a concentration of between 4 and 8 mg / l, it leads to the risk of fluorosis skeletal [1].

The water of El Oued is characterized by high concentrations of fluoride, associated with severely high and excessive total mineralization. This water is the only source of drinking . The hot and dry climate has forced people to consume a lot of water which leads to raise the daily consumption rate of fluoride, in addition the eating a lot of dates and tea leads to the spread of Fluorisis disease which is carracterized by the yellowish of tooth enamel according to the classification of the national program of school health [2], [3].To prevent these diseases from happining or reduce them many techniques of defluoridation are used such as: membrane technologies, precipitation and adsorption .We focused our work on a comparative study between precipitation methods with different salts of calcium and identify the optimal conditions of the factors influencing the removal of fluoride from drinking water in El -Oued.

EXPERIMENTAL SECTION

1. Preparation of curve witness fluoride:

To determine the concentration of fluoride in various samples we used potentiometer method by (Rodier2005) [4]. We prepared different standard concentration solutions from NaF salt. Then we measured their potential by using specific fluoride pole (ISE15381/1) and a pH-meter model (pH211) with means of polyethylene, using a solution of TISAB and we draw the curve $E=f(\log C_F)$ presented in Figure(1).

2. Determination of fluoride concentration in some samples of the study area:
The concentration of fluoride has been determined in some water sources of the study area in order to determine and treat the largest content of fluoride. The results are presented in the table (1). The selected sample (cold water of Shuhada) has a concentration of fluoride 2.61 mg / l.

3. Determination of the predominant concentration of ions in the studied water:
The study was done according to (Rodier2005) [4] on cold water of Shuhada as follows:

- **Chlorides:** volumetric method for Mohr.
- **Nitrates and sulfates**: spectroscopy method (UV) ray using (spectrophotometer DR 2400).
- **Alkalinity:** by determining TA and TAC using PhPh and MO indicators respectively.
- **Calcium concentration:** by complexity with EDTA in the presence of Murexide at pH=12.
- **Total hardness:** by complexity with EDTA in the presence of *Eriochrome Black T* at buffer solution of pH=10.
- **Magnesium concentration**: **calculated** from the difference between Total hardness and calcium concentration.
- **Sodium and potassium:** by flame atomic absorption analysis .

RESULTS AND DISCUSSION

Results of predominant ions are presented in table (2)**.**

4. Treatment: We studied the factors affecting (mass, pH, and temperature T) by the precipitation method using $CaCl_2$ salt.

4.1. Effect of calcium concentration:
Based on the precipitation of fluoride in the form of CaF_2 low soluble according to equilibrium (1). 100 ml of Shuhada water was put in each cup of plastic then the pH and temperature T were measured ,after that different amount of the same salt was added to each cup ,after stiring for 3 minutes ,they are let for a while then filtered, finelly the amount of fluoride in the filtrate were measured .The results were presented in table (3) and figure(2).

4.2. Effect of pH :
Based on orionting the equilibrium towards the precipitation of fluoride in the form of CaF_2 according to the relation (1).We repeat the same steps of the previous experiment as mentioned in (5.1) by fixing the temperature and the added optimal mass of $CaCl_2$,but changing the pH by buffer solutions. The results were presented in table (4) and figure(3).

4.3. The effect of temperature T:
We repeat the same steps of the experiment as mentioned in (5.1) by fixing the added optimal mass of CaCl2and the optimal pH,but changing the temperature. The results were presented in table (5) and figure(4) [5].

5. Equations and equilibriums:

$$\boldsymbol{CaF_2 \rightleftharpoons Ca^{2+} + 2F^-} \ldots\ldots (\mathbf{1})$$

$$[\boldsymbol{F^-}] = \sqrt[3]{\left(\boldsymbol{2K_{SP}}[\mathbf{1} + \frac{[\boldsymbol{H^+}]}{\boldsymbol{K_a}}\right)^{\mathbf{2}}} \ldots\ldots (\mathbf{1})$$

Table 1: Fluoride concentration for some water in the study area

Sources of water	19mars city	Sidimastur city	400 city	Tugurt city	8may city	1Nov city	Nezla city	Shuhada
Concentration of F^-	1.87	1.90	1.92	0.44	1.84	1.94	0.46	2.61

Table 2: physico-chemistry properties of Shuhada water

property	SO_4^{2-}	Ca^{2+}	Mg^{2+}	Na^+	K^+	NO_3^-	TA	TAC	Cl^-
C(mg/l)	544	492	140	54.93	2.41	5.9	0	105	402

Table3:Effect of calcium on the fluoride:

Concentration of Ca^{2+} (g/l)	0.72	0.93	1.44	3.6	10.82
Concentration of F^-(mg/l)	1.63	1.56	1.46	1.32	1.15

Table4:Effect of pH on the fluoride:

pH	4	5	6	7	7.5	8
Concentration of F^-(mg/l)	1.87	1.78	1.69	1.61	1.56	1.52

Table5:Effect of temperature on the fluoride:

T(° C)	20	29	30	40	45
Concentration of F^-(mg/l)	2.04	1.5	1.41	1.08	0.91

Figure1: The witness graph for fluoride

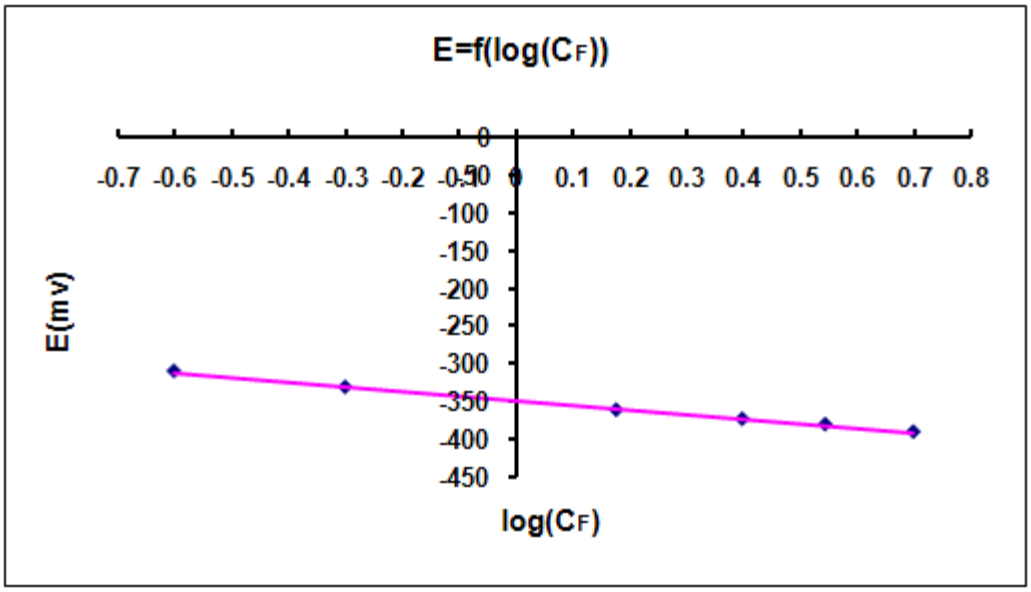


Figure2: variation of residual fluoride against added calcium concentration

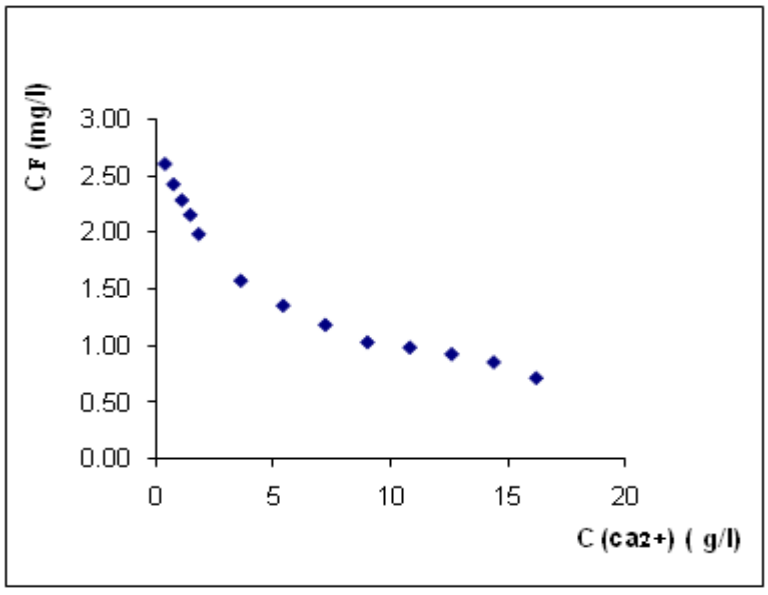


Figure3: variation of residual fluoride against pH

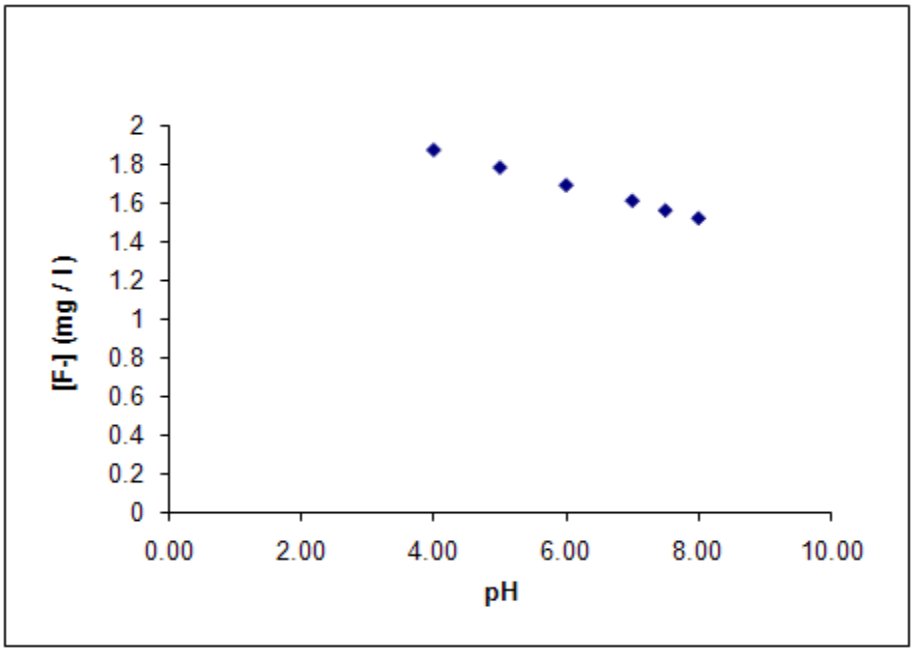
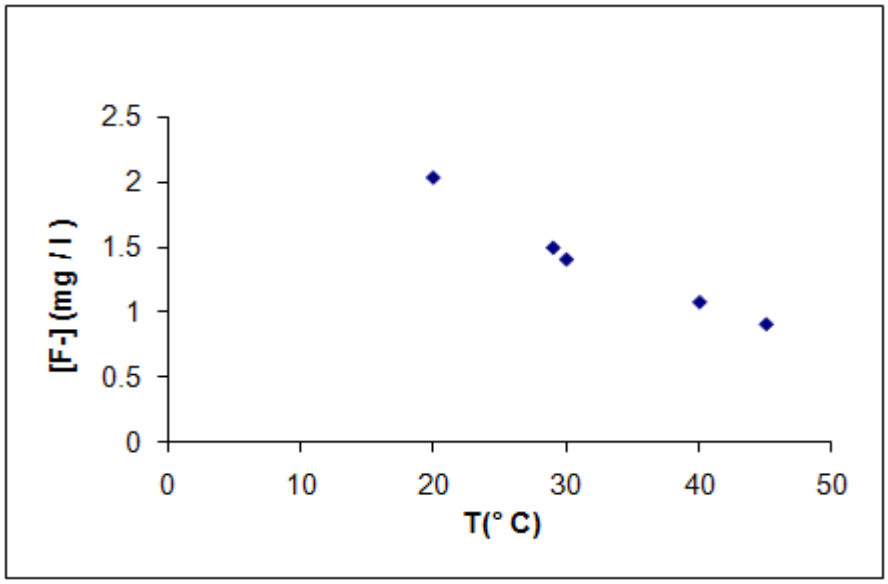


Figure 4: variation of residual fluoride against temperature



CONCLUSION

- According to the quantity of fluoride in the water of some region of El-Oued,it appear that most of them Contain surplus exceeds the standard value of (WHO) with a total high hardness.
- through the study of factors affecting (mass, pH, temperature) it is possible to choose the best conditions for a reduction process with calcium chloride by adding an amount with a concentration of 3.6 g / l , pH=8 and a temperature of 29 °c.

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