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Defluoridisation of Water Using Advanced Cationic Fluoride Scavengers

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Abstract- *Defluoridisation is the process of removing fluorine and its impurities from water. For this purpose, rather than sequestering the fluoride produced by Di isopropyl fluorophosphates hydrolysis with excess urease, cationic fluoride scavengers may be added to reduce the concentration of fluoride to non-inhibitory levels. This can be achieved by using cationic fluoride scavengers. Cationic scavengers include Calcium, Magnesium, nickel, lanthanum etc. Such scavengers are able to bind to fluorine resulting in the formation of an insoluble salt which can be filtered out. Although the extent of precipitation of salt is dependent upon its solubility product constant(Ksp).The Ksp for several fluoride salts including calcium fluoride, magnesium fluoride and lanthanum fluoride at ambient temperature are 5.3*10^-9,5.16*10^-11,and 7.0*10^-17 respectively. The capacity of calcium, lanthanum and nickel was determined by assaying urease activity in the presence of fluoride and the respective scavenger. Calcium and nickel are both divalent cations and thus can complex two fluoride ions per molecule of cation whereas lanthanum which is trivalent can bind three fluoride ions per cation molecule. To mimic the case in which the cation scavengers and urease would complete for fluoride as it is released by the hydrolysis of Di isopropyl fluorophosphates, the cations in the form of organic salts were added to the fluoride containing substrate solution immediately prior to the addition of enzyme.*

Keywords**:** *Defluoridisation, urease, scavengers, cation*

I. INTRODUCTION

Fluorine is an essential trace element for human health, but exposure to fluorine in excess amounts may cause dental and skeletal fluorosis[1][2]. Even though the absence of fluorine does not cause dental caries, injection of fluorine may help reduce tooth decay. The effect of fluorine depends on its total daily intake from all sources. Drinking water is typically the largest source of fluorine; other methods of fluorine therapy include fluoridation of tooth paste, salt and milk. Since the amount of fluorine intake is important, fluorine contents of water, beverages and many food and drink samples have been investigated deeply in literature.

Through this experiment we would be using some cationic scavengers to remove the excess presence of fluorine by column study and determine the absorbance and transmittance by UV Visible Spectroscopy.

II. MATERIALS AND METHOD

A sample of fluoridised water, an absorption column for passing the fluoride sample, necessary cationic scavengers like calcium magnesium (in the form of salts).A spectrophotometer is used to detect the absorption and transmission of fluoride by these scavengers.

A solution of artificial fluoride sample was prepared (20mg/L and 40mg/L) and well shaken to make the composition uniform. The column was fixed in a stand which is covered by a filter paper and corresponding stoichiometric amounts cationic salts were filled into it to a height of 5cm.About 100 ml of the sample was taken and its ph is made about 3 by adding required 1ml of HCl into it because rate of absorption will be greater in acidic medium. The sample was slowly fed through the cationic bed with a flow rate of 3ml/min and corresponding fluoride salts were formed which was precipitated out. The clear solution was taken and the amount of absorbance and transmission is measured for wavelength of fluorine using a Systronics UV Visible spectrophotometer[3].

III. RESULT

It was found that the absorbance of fluorine in different solutions was less than that in the sample created which prove the removal of fluorine from the sample.

- FOR A CONC. OF 20 mg/L

The absorbance of sample for fluorine at 450 nm was found to be .025.The transmission at 250 nm was found out to be about 81.8.The absorbance and transmittance of this sample with corresponding cationic samples has been tabulated as follows

ABSORBANCE

Sample Scavenger	Wavelength (nm)	Absorbance
$Ca(No_3)_2$	450	0.021
$CaCO_3$	450	0.018
$Mg(NO_3)_2$	450	0.015
$MgSo_4$	450	0.023
La_2O_3	450	0.013

TRANSMISSION

Sample Scavenger	Wavelength (nm)	Transmission (%)
$Ca(No_3)_2$	250	86.4
$CaCO_3$	250	91.8
$Mg(NO_3)_2$	250	92.3
$MgSo_4$	250	84.2
La_2O_3	250	94.2

- FOR A CONC. OF 40 mg/L

The absorbance of sample for fluorine at 450 nm was found to be .030.The transmission at 250 nm was found out to be about 47.1. The absorbance and transmittance of this sample with corresponding cationic samples has been tabulated as follows

ABSORBANCE

Sample Scavenger	Wavelength (nm)	Absorbance
$Ca(No_3)2$	450	0.012
CaCO3	450	0.014
$Mg(NO_3)_2$	450	0.011
$MgSo_4$	450	0.016
La_2O_3	450	0.009

TRANSMISSION

Sample Scavenger	Wavelength (nm)	Transmission (%)
$Ca(No_3)2$	250	92
CaCO3	250	90.2
$Mg(NO_3)_2$	250	94
$MgSo_4$	250	88.2
La_2O_3	250	96

IV. CONCLUSION

From theoretical aspects, we get that the maximum transmission is for lanthanum oxide as it has more voidage and can trap fluorine molecules than the other cations. From the experimental result, it is confirmed that the maximum removal of fluorine is done by lanthanum oxide.

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VI. REFERENCES

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