

# ANALYSIS AND PREDICTION OF CANCER RATES BEFORE AND AFTER STERLITE

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## ABSTRACT

This study is to analyse the hazards of Sterlite Copper Plant in Tuticorin region. The main focus of our study is the analysis of cancer rates in Tuticorin. The datasets are obtained with a scope for analysis by considering the rates of cancer causing agents, thus predicting the increase or decrease in the rates of the cancer-causing agents if the Sterlite Copper Plant was not closed in the coming years. The factor that we are taking into consideration is the rates of such agents found in water bodies during the years of 2007-2018. This is implemented by using the trend for the year 2017-18. The predictions are done using regression analysis by taking the factors as the cancer-causing agents and the year. The inferences would be whether the cancer rates have been influenced or has remained the same irrespective of the functioning of the Sterlite Copper Plant.

**KEYWORDS:** Cancer rates, Tuticorin, regression analysis.

## 1. INTRODUCTION

The closing of the Sterlite copper plant has been the talk of the town for the past few weeks. The operation of this plant has caused a lot of uproar amongst the people of Tuticorin as the plant was accused of disposing untreated waste which causes a lot of diseases including various types of cancer. There were many controversies surrounding this organization since its establishment. After the state governments of Maharashtra, Goa, Gujarat rejected this project, the company with the support of Tamil Nadu's state government, set up its plant at Tuticorin in 1994. The first complaints came in the year 1997, where the locals complained about having minor

headaches, cough and choking due to the emanating smoke from the plant. Many cases of cancer were reported during the functioning of this plant. Some of the most reported cases were diagnosed of liver cancer, tract cancer and skin cancer.

## 2. RESEARCH METHODOLOGY

A survey and a few tests done to the district has proven the rates of these agents have been increased significantly. All these agents and their rates have been taken into consideration from the years 2007-2018. Their safety limits have been checked and analysed. The values to be predicted are forecasted using multiple

regression method. The levels of SO<sub>2</sub>(sulphur), CO<sub>2</sub>(Carbon), F(Fluorine), Cl(Chlorine) are taken into consideration as these are the main factors causing cancer. The rates of increase of these agents are compared to analyse the hazards of this copper plant. The rates of these agents are predicted for the upcoming years of 2019 to 2023.

**Copper (Cu):** According to many studies, Copper has been found to be the main factor causing cancer. The metal has been found out to be present in the tumour cells, thus causing an imbalance to the body.

**Fluorine (F) and Chlorine (Cl):** These two halogens are consistently present in water bodies everywhere. These are toxic in nature, if taken in disarranged amounts.

**Magnesium (Mg):** According to recent studies, it has been proved that Magnesium is one of the agents which supports in the strengthening of tumour cells as it provides nutrition to the tumour cells.

Multiple regression is done by taking Cu as the dependent variable and taking F, Cl and SO<sub>4</sub> as the independent variables. The regression coefficients are found, and they are substituted in the formula:

$$Y = \alpha + a_1X_1 + a_2X_2 + \dots + a_nX_n$$

**Where,**

$\alpha$  is the intercept.

$a_1 \dots a_n$  are the values taken for each factor.

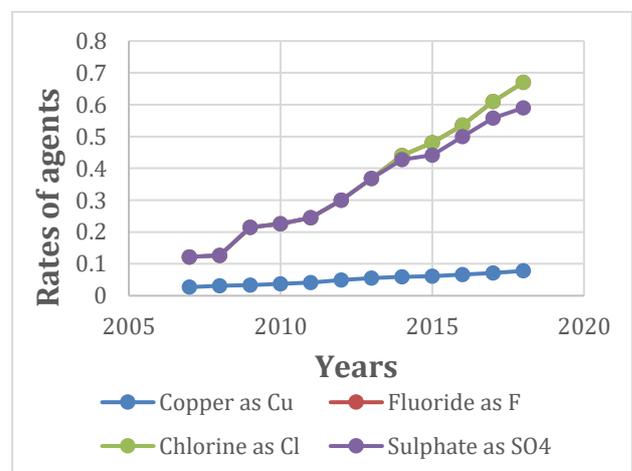
$X_1 \dots X_n$  are the coefficients of the agents.

### 3. DATA ANALYSIS

Year	Copper	Fluoride	Chlorine	Sulphate	Magnesium	Calcium
2007	0.027	0.122	0.122	0.122	0.098	0.073
2008	0.031	0.127	0.127	0.127	0.101	0.082
2009	0.033	0.215	0.215	0.215	0.113	0.091
2010	0.037	0.226	0.226	0.226	0.125	0.099
2011	0.041	0.245	0.245	0.245	0.134	0.113
2012	0.049	0.3	0.3	0.3	0.169	0.133
2013	0.055	0.368	0.368	0.368	0.201	0.168
2014	0.059	0.441	0.441	0.428	0.251	0.186
2015	0.061	0.481	0.481	0.442	0.289	0.199
2016	0.066	0.536	0.536	0.5	0.311	0.226
2017	0.071	0.61	0.61	0.558	0.357	0.278
2018	0.078	0.67	0.67	0.59	0.41	0.301

**Table 1:** Relative weights of chemical parameters of Tuticorin taken from the years 2007 to 2018. [1][2][3][4]

The above table contains data of the chemical parameters such as Cu, F, Cl, SO<sub>4</sub>. Multiple linear regression method is used for formulating the levels of Cu by taking it as the dependent variable and taking the levels of fluoride, chloride and sulphate as the independent variables and the results representing the collective rate of Cu in water bodies of Tuticorin are shown in a line graph.



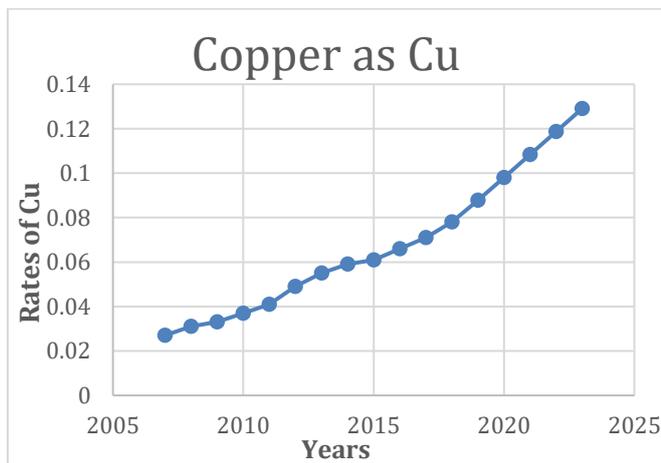
**Figure 1:** Collective rate of Cu in water bodies of Tuticorin.

The above graph represents the rates of Copper, Fluorine, Chlorine, Sulphate with respect to time (in years). The rates of these compounds/elements are taken in the X-axis and the time (in years) are taken in Y-axis.

Year	Cu
2019	0.087740339
2020	0.098075445
2021	0.108410552
2022	0.118745658
2023	0.129080765

**Table 2:** Predicted values of Cu for the years 2019-2023.

The above table represents the values of Cu predicted by using multiple regression analysis for the years 2019-2023. Cu is taken as the dependent and the rest are taken as independent variables since Cu is found to be the most dangerous cancer-causing agent.

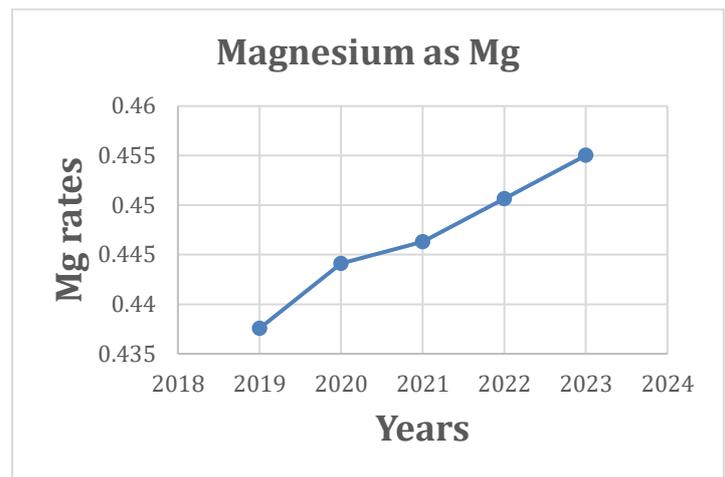


**Figure 2:** Predicted values of Cu for 2019 to 2023.

The above graph represents the predicted rates of Cu with respect to time (in years). The time(in years) is taken as X- axis and the rates of Cu are taken as the Y-axis.

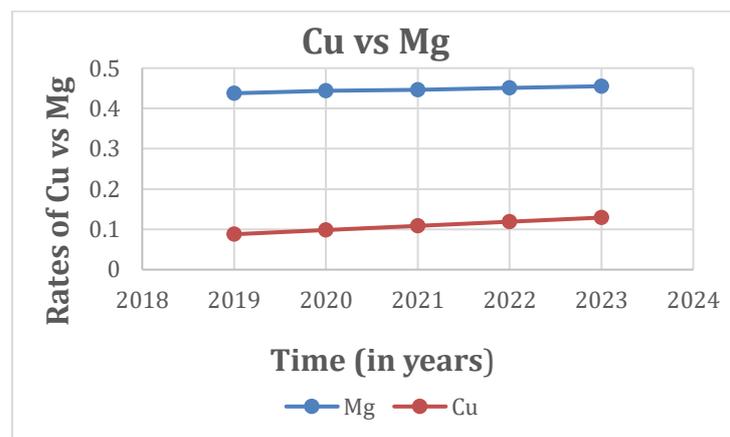
Year	Mg
2019	0.437557
2020	0.444097
2021	0.44629
2022	0.450657
2023	0.455024

**Table 3:** Predicted value of Mg for the years 2019 to 2023.



**Figure 3:** Predicted values of Mg in the years 2019 to 2023.

The above graph represents the predicted rates of Mg with respect to time (in years) . The time (in years) is taken as the X- axis and the rates of Mg is taken as Y- axis.



**Figure 4:** Comparison of Copper (Cu) and Magnesium (Mg).

The above graph represents the comparison of Magnesium (Mg) and Copper (Cu) with respect to time (in years). The time (in years) is taken as the X- axis and the rates of Cu and Mg are taken as the Y- axis.

#### **4. INTERPRETATIONS**

From the above conducted analysis of rates of the cancer-causing agents it has been found that the rates of these agents have always been increasing throughout all the years that is from 2007-2018. The rate of Cu has been extensively increasing and has been forecasted to be increasing in the years 2019 to 2023. The rates of Mg have also been extensively increasing and has been forecasted to be increasing in the years 2019 to 2023. Magnesium was found to be the second most prevalent component in tumour cells.

#### **5. CONCLUSIONS**

The main purpose of introducing this Copper plant in India was to increase the rates of production of Copper. Many controversies were surrounding this copper plant. The Madras High Court had fined this company Rs.100 crore in the year 2010 for polluting the environment. After increasing number of complaints, and the industry violating multiple laws such as the Water Act of 1974 which states that the hazardous industry should be located at least 25 kms away from any eco-sensitive area and other norms framed by the Tamil Nadu Pollution Control Board. The factory has been shut down several times, only

to be allowed to reopen in a few days [5]. After the infamous Tuticorin massacre, the Tamil Nadu government decided to permanently shut down this copper plant. The rapid increase in the rates of these agents are studied in this paper. This study tells that the rates of these agents are way above the safe level recommended by WHO. If this copper plant were to be functioning today, it would have dumped more untreated waste which would lead to increase in Cancer rates. This project could further be expanded by taking into consideration other factors such as air and soil pollutants, since they also play a major role in increasing the impact. This study is concluded by inferring that the copper plant would have had a negative impact on the health of the people.

#### **6. REFERENCES**

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