

# Possible relationship existing in the distribution of electrolyte between the soap and the lye

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**Abstract.** The study on the distribution of electrolyte between soap and lye was investigated for twenty samples of soaps produced by saponification process. Each set of five replicate samples of soaps were salted out by 10g, 20g, 30g, and 40g of common salt (NaCl). The distribution ratios for the corresponding soaps were  $4.5 \times 10^{-4}$ ,  $1.5 \times 10^{-4}$  and  $2.06 \times 10^{-5}$ ,  $3.25 \times 10^{-4}$ . The produced soaps and the lye were analysed for chloride content according to approved and recommended methods of analysis. The result of the analysis shows that the chlorides were highly distributed in the lye than in the soaps. Correlation between the amount of chloride in the soap and in the lye shows a significant negative correlation ( $r = -0.8664$  at  $P = 0.05$ ). The regression equation relating the amount of chloride in the lye ( $Y_1$ ) and the amount of the chloride added during the saponification process ( $X$ ) was found to be  $Y_1 = -4.79 + 1.18X$  while the equation relating the amount of chloride in the soap ( $Y_2$ ) and the amount of added chloride ( $X$ ) was found to be  $Y_2 = 0.005518 + 0.001246X$ .

**M.S.C. 2000:** soap, electrolyte, distribution relationship.

**Key words:** 92-xx, 92F05.

## 1 Introduction

The distribution of an electrolytes such as common salts (NaCl) between two immiscible liquids is governed by a chemical law and the ratio of the concentration of the electrolyte in the first layer to the concentration of electrolyte in the second layer bears a constant value called the distribution ratio. However, situation differs when a solute is distributed between a liquid layers which is in contact with a solid mass (Atkin, 1990)

In the production of soap by saponification of oil, the basic reaction that takes place is that which occur between the oil and, alkali in the presence of a salt such as chloride. The role of the added electrolyte is in the salting out of the produced soap (Woollatt, 1985). It has been established that the products of saponification are soap and lye (Davidson et al (1953)).

In most traditional method of soap making, common salt is normally added to facilitate the salting out of the soap. The addition of common salt is often done without accurate knowledge of the required amount needed for the production of soap of required quality. This arbitral and uncontrolled addition of common salt to the saponification tank makes it difficult to establish the stoichiometric relationship between the amount of electrolyte added and the amount absorbed by the soap or the lye.

Caustic soda is a strong electrolyte and its catalyzed saponification reaction. Woollatt (1985) noted that when some soap is present, too much electrolyte will salt or grain out the soap and greatly slow down the saponification reaction. It has also been found that too little of the electrolyte will cause bunching or thickening<sup>7</sup> thus it is necessary to ensure that the electrolyte content of the soap is within the required limit.

Much research has been done on soap but in most of these researches is centred on the production process, KCl is the most widely studied electrolyte and the palm oil and palm kernel oil are mostly excluded from these studies. Consequently since the cheapest raw materials in Nigeria, for the production of soap is palm oil, palm kernel oil, common salt and caustic soda, the present research is aimed at establishing the quantitative relationship existing between the distribution of electrolyte in the soap and the lye during saponification of palm kernel oil.

## 2 Materials and Methods

The raw materials used for the production of the soap were palm kernel oil, caustic soda and common salt. The soap was produced by the cold method of preparation as reported by Woollatt (1985). This was done by reacting standard solution of caustic soda (of required relative density) with the palm kernel oil sample. Common salt was added as the stirring of the reactants continues.

The chloride content of the soap and the dye was determined by titration with 0.2M AgNO<sub>3</sub> after the soap has been dissolved in calcium trioxonitrate (Bassett et al, 1989).

## 3 Results and Discussions

The result of the mean concentration of chloride in the soap and lye and their distribution ratios are presented in table 1.

Sample	Am-a	Am-s	Am-l	Dr
A	10.00	9.99	0.0045	$4.5 \times 10^{-4}$
B	20.00	19.99	0.0030	$1.5 \times 10^{-4}$
C	30.00	28.99	0.0006	$2.06 \times 10^{-4}$
D	40.00	39.99	0.0013	$3.25 \times 10^{-4}$

Table 1: The distribution of chloride in the soap and in the lye.

where Am-a = Amount of  $Cl^-$  added (g), Am-s = Amount of  $Cl^-$  in the soap (g), AM-l = Amount of  $Cl^-$  in the lye (g) and Dr = Distribution ratio.

The chloride content of the lye was found to be higher than that of the soap. The distributions of chloride in both cases were found to increase as the amount of added chloride increases.

The ratio of the chloride content of the soap to that of the lye on addition of 10g, 20g, 30g, and 40g of NaCl were  $4.5 \times 10^{-4}$ ,  $1.5 \times 10^{-4}$ ,  $2.06 \times 10^{-5}$  and  $3.25 \times 10^{-4}$  respectively. These ratios differ for the different soap samples. Correlation between the amounts of chloride in the different soaps shows a significant negative correlation ( $r = -0.8664$ ,  $P = 0.05$ ). This implies that the degree of linear relationship between the two is negative because when one decreases, the other increases. This is confirmed by the linearity of the regression plot given in figure 1 and figure 2.

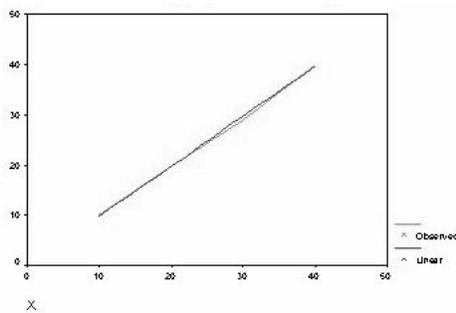


Figure 1: Chloride in Soap (Y) against Chloride added (X)

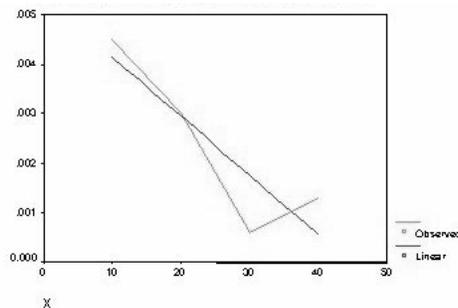


Figure 2: Amount of Chloride in Lye (Y) against amount added (X)

Figure 1 and figure 2 shows that the plot of the ratio, amount of chloride in the soap and the amount of chloride in the lye respectively. The plot for the amount of added chloride is a U-shape curve and implying that as the amount of added chloride increases, the ratio decreases reaching its minimum value when 0.3g of chloride is added after which it increases. Below this minimum value the distribution ratio decreases as the amount of added chloride increases but increases as the amount of added chloride increases. This trend can be explained in terms of the sudden changes in the reaction condition at that point.

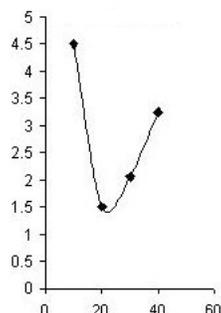


Figure 3: Distribution ratio of Chloride in Soap against amount of chloride added

The regression equation relating the amount of chloride in the lye ( $Y_1$ ) and the amount of added chloride was found to be  $Y_1 = -4.79 + 1.18X$ . This shows that the slope is negative consequently the rate of change in the concentration of chloride in the lye with respect to the concentration of chloride added is 1.18. Similarly the relationship between the concentration of chloride in the soap ( $Y_2$ ) and the concentration of the added chloride was found to be  $Y_2 = 0.005518 + 0.001246X$ . This gives the rate of change of 0.001246.

## 4 Conclusion

The result of the analysis shows that there is a linear relationship between the concentration of chloride in soap and in the lye during saponification. The distribution coefficient as it applies to soap has also been found to depend on the amount of added electrolyte.

It is interesting to note that different oil undergoes saponification at different rate therefore the distribution coefficient of different oil is expected to differ. The concentration of the alkali and the type of alkali may also influence the distribution of electrolyte between the soap and the lye. The used of KCl instead of NaCl may contribute to the value of the distribution coefficient of the chloride.

In view of the above fact and established relationship, It is imperative that accurate knowledge of the relationship between the added electrolyte and the adsorbed or adsorbed electrolyte is necessary if a good quality soap must be produced.

It is hereby recommended that research on the possible relationship existing between the added electrolyte and the distributed electrolyte for different oil and different alkali should be conducted and documented for industrial use.

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