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Physico-Chemical and Thermo gravimetric Analysis of Rubidium Soaps in Solid State

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A B S T R A C T

Rubidium soaps (Caprylate, Myristate and Pamitate) were analyzed thermally using TGA Technique and thermo grams were obtained to determine their energy of activation. These soaps show single step thermal degradation. The TGA data have been investigated in terms of Freeman andcarroll equation. Coats-Redfern, Horowitz-Metzger equations have also been applied successfully to evaluate the energy of activation. The process of decomposition reaction is kinetically of zero order and energy of activation for these soaps liein the range 5.4-5.6 Kcal mol^{-1}

Keywords: kinetically, activation, Coats-Redfern, soaps, thermally, TGA, degradation

A R T I C L E I N F O

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1. Introduction

The nature and structure of the metal soaps play a vital role for its applications in various fields such as medicine, cosmetics, catalyst and emulsifier. Recently, the thermal studies of metalsoaps have aroused much interest [1-7] in order to obtain structural information on metal soaps in pure crystalline state. S. K. Upadhyay et al [8] characterized

Dysprosium soaps in solid state by thermal measurement. Rajesh Dwivedi et al. [9] carried out thermal degradation of erbium Soaps in inert atmosphere to determine order of reaction and energy of activation. B.S. Randhawa et al [10] studied thermal analysis of alkali metal succinates by employing simultaneous non-isothermal techniques (DTG, DTA and TG) to compare their stability order.si, P. S.Bassi et al. [11] examined certain alkali metal malonates by employing non isothermal analysis and determined their order of reaction and energy of activation. Muraishi, Kazuo et al.[12] carried out thermal decomposition of alkali metal malonate anhydrides in various atmospheres using TG-DTA indicated a trend in activation energy for their stability.

2. Experimental

Soaps were prepared and purified by recrystallization [13] with pure and dried ethanol and the purity of soaps was confirmed by elemental analysis and by determining their melting points.

Rubidium Caprylate: 210.0^0 C

Rubidium Myristate: 212.0^0 C

Rubidium Palmitate: 208.0^0 C

The thermogravimetric analysis of rubidium soaps (caprylate, myristate and palmitate) of same particle size was carried out at constant rate of heating under similar atmospheric condition in a crucible of same size and material in a thermos balance manufactured by Fertilizer Corporation of India, Sindri.

3. Results and Discussion

The results of Thermo gravimetric analysis of rubidium soaps are given in Figs.1&2. It is found that the final residues are the rubidium carbonates and the weights of the residues are almost in agreement with the theoretically calculated weights of rubidium carbonates from the molecular formula of corresponding rubidium soaps. Therefore the decomposition of rubidium soaps can be expressed by the equation (1)

2Rb (R COO) =R CO R +Rb_2CO_3 .... (1)

Where R = C_7H_{15}, $C_{13}H_{27}$ and $C_{15}H_{31}$

It may be pointed out that some white crystalline powder was condensed at cold part of the sample surrounding the soap detected as ketone, (caprylone, myristone& palmitone)

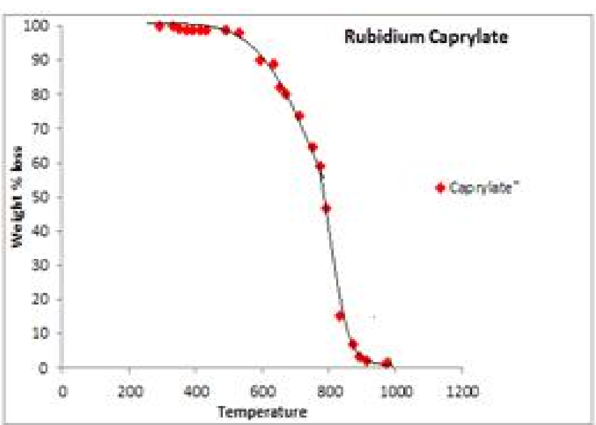

Figure1: Temperature vs Weight % loss

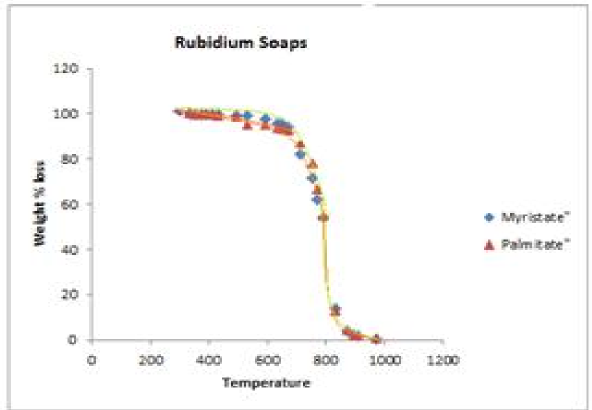

Figure 2: Temperature vs Weight % loss

Thermo gravimetric analysis shows that these soaps decompose insignificantly in the early stage of heating up to 362^{O}C slowly between362^{O}C and 537^{O}C then very rapidly up to802^{O}C almost becomes stable up to quite higher temperature 820^{O}C due to conversion in to carbonate and ketone. Fig.1& 2. Thermo gravimetric data from the study of kinetics of thermal decomposition of soaps were used to calculate the energy of activation and to find the order of reaction using Freeman and Carroll's rate expression[14] for the thermal decomposition of these soaps where soaps disappeared continuously with the one of the product being gaseous and Freeman-Carroll's expression can be expressed as:

$$\frac{\Delta \text{Log}(dw/dt)}{\Delta(\log w_r)} = -\frac{E}{2.303\,R} \cdot \frac{\Delta(I/T)}{\Delta(\log w_r)} + n$$

Where, E= Energy of activation, *n* = order of reaction,

T = temperature on absolute scale

w_r = difference between the total loss in weight and loss in weight at time *t* i.e.

$w_0 - w_t$, dw/dt = rate of weight loss obtained from the loss in weight of soaps and the loss at predetermined time.The activation energy for thermal decomposition process of rubidium soaps has been calculated from the plots of Δlog (dw/dt)/Δ(logw_r) vs Δ(1/T)/Δ(logw_r) which are linear.Fig. 3, 4 and 5

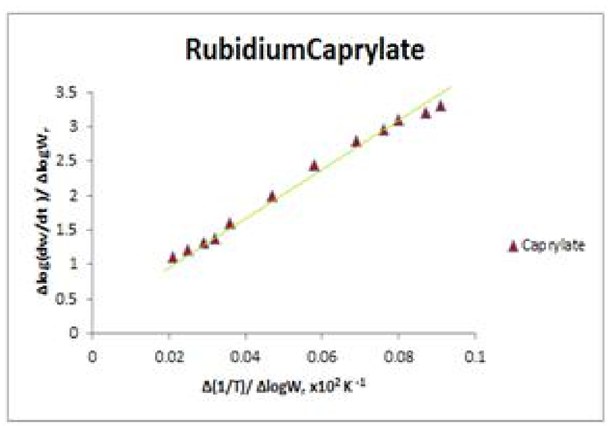

Figure 3: △ Log(dw/dt)/△(logwr) vs △(I/T)/△(log wr)

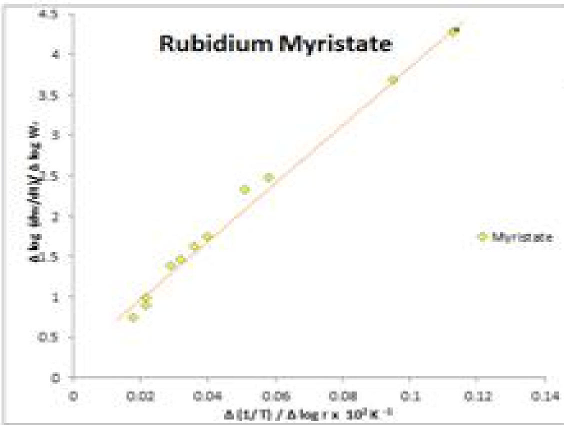

Figure 4: △ Log(dw/dt)/△(logwr) vs △ (I/T)/△(log wr)

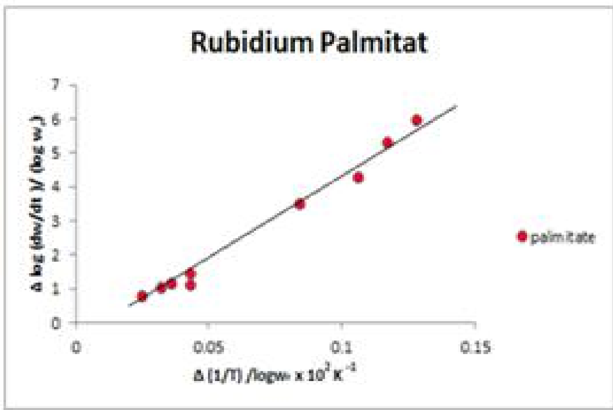

Figure 5: △ Log(dw/dt)/△(logwr) vs △ (I/T)/△(log wr)

The order of reaction for the thermal decomposition of rubidium soaps has been found almost zero and the values of energy of activation for thermal decomposition for rubidium soaps (Caprylate, Myristate and Palmitate) are 5.4- 5.6 Kcal. mol^{-1} respectively table 1. Coats-Redfern equation has also been used in calculating the energy of activation since it is useful for kinetic analysis, [15]

$$\text{Log}\left[\frac{[-\ln(1-\alpha)}{T^2} - \frac{\log ZR}{qE}\left[1-\frac{(2RT)}{E}\right]\right] - \frac{E}{2.303\,RT}$$

The plots of -log (1- α) / T2 vs 1/T are linear and the values of activation energies evaluated from the slope of these plots recorded in Table- 1 which are in good agreement with that of Freeman-Carroll's expression. Horowitz-Metzgeequation [16] has also been used to evaluate the value of 'E'.(energy of activation) for comparison .The Horowitz-Metzger equation is as follows.

$$\ln[\ln(1-\alpha)-1] = \{ \frac{E-\theta}{RT^2} \}$$

4. Conclusion

The accurate determination of kinetic parameters from thermo gravimetric data for soaps material provide kinetic parameters giving information for designing the environmental history / thermal stability of a soap .These soaps may inhibit the dehydro chlorination reaction when PVC is subjected to heat and suitable as stabilizer for PVC.

Table 1 Energy of activation in $Kcal.Mole^{-1}$for decomposition of Rubidium soaps

S.No	Name of soaps	Freeman –Carrol	Coats –Redfern	Horowitz Metszer
1	Rubidium Caprylate	5.5	5.5	5.6
2	Rubium Myristate	5.5	5.4	5.6
3	Rubidium Plmitate	5.6	5.5	5.4

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6. References

[1] A. Rasheed,R. A. Bhobe.thermal decomposition and dielectric relaxation studies of zinc (II) stearate,J. Indian Chem. Soc., 1976, 53, 442

[2] K. N. Mehrotra, M. K.Rawat.physico chemical studies on manganese soap in solid state ,colloid polymer science ,1992,270:1232-1236 ,

[3] M. J. Vold, R. D.Vold. the phase behavior of lithium Stearate in cetane and in decalin, Journal of Colloid Science ,1950- Elsevier

[4] F.H. Stross, S.T. Abram. Thermal Analysis of the System Sodium Stearate-Cetane,*J. Am. Chem. Soc.*, 1951, 73 (6),pp 2825–282

[5] K. N.Mehrotra,M. Jain. spectroscopic and thermal behavior of chromium soaps,journal of solid state chemistry,1996,vol.122, issue 1,pp 100-106

[6] G. S. Hattiangdi. M. J. Vold,R. D. Vold. differential Thermal Analysis of Metal Soaps, Ind. Eng. Chem.,1949,41 (10), pp 2320–2324

[7] R. D.Vold, J .M.Vold. thermal Transitions of the Alkali Palmitates,*J. Phys. Chem.*, 1945, 49 (1), pp 32–42

[8] S.K. Upadhaya, R.K. Shukla,G.Sharma .infrared, thermal and X-ray diffraction analysis of dysprosium soaps, Asian j. of chem., 2007,vol.19, no.5, 3487-3492

[9] R. Dwivedi, B. Ganwar, M. Sharma. physicochemical studies on eribium Soaps of Saturated Higher Fatty Acids in Solid

State,*Int*.J.Curr.Microbiol.App.Sci,2014,3(9), 501-504

[10] B.S. Randhawa, H. K.Sandhu. comparative studies of thermal analysis alkali metal succinate, thermo chimica Acta,1988,volume 132,pages 229-233

[11] P.S. Bassi, B.S. Randhawa, S. Kaur. Thermal analysis of certain alkali metal malonates, Asian Journal of Chemistry,1992, 4.2, 267-274

[12] K. Muraishi. thermal decomposition of alkali metal malonate anhydrides in various atmosphere, Thermo chimica Acta , 1990,vol. 164, Pages 401-409

[13] K.N .Mehrotra, S.P.S. Saroha. Studies on infrared spectra and thermal analysis of rubidium soaps, J. Indian. Indian. Chem. Soc., 1979 , LVI: 466-469.

[14] E.S .Freeman,B. J Carol. The thermo gravimetric evaluation of the kinetics of the decomposition of calcium oxalate monohydrate, J. Phys. Chem., 1958, 62(4), 394

[15] H.H. Horowitz,G. Metzge. a new analysis of thermo gravimetric traces ,Anal. Chem., 1963,35,464,

[16] A.W. Coats, J. P.Redferns, kinetic parameters from thermo gravimetric dataNature, 1964, 68, 201,