The following conclusions are drawn from the experimental study of variation of hardness (expressed by knoop hardness number) of cleavage faces of synthetic single crystals of NaCl, KCl and KBr with applied loads, orientation of major diagonal of knoop indenter with reference to direction [100] and quenching temperatures.

1) For all these three crystals, the graph of log d Vs. log p consists of two clearly recognizable straight lines having different slopes (n_1 & n_2) and intercepts (a_1 & a_2) on the axis of low and high loads respectively.

2) The variation in the exponent of 'd' can be eliminated by employing modified kick's law, where the exponent is $\approx$ 2 and standard hardness values a_2 replaced by b_2 in the HLR. This study clearly shows that modified kick's law is applicable only in the HLR region.

3) With increase in orientation from 0 to 90°, the values of n_1 and n_2 are decreasing with increase in orientation, attain minimum values at about 45° orientation whereas converse is true for a_1 and a_2 and the behaviour is independent of the temperature.

4) The analysis based on the phenomenology of cleavage faces of NaCl, KCl and KBr has clearly indicated that for studying variation of load with diagonal length of the knoop indentation mark, the direction [110] or family of direction $\langle 110 \rangle$ is important and should be considered as a reference direction instead of direction [100].

5) From the present analysis, the statement of kick's law and modified kicks law could be revised and restated.

6) The present study has convincingly shown that a crystal surface in particular and a crystal in general is characterised by a pair of anisotropic constants (n_1, a_1) in LLR and (n_2, a_2) in HLR and (b_2, w_2) when modified kick's law is applied.

7) Hardness varies with load. For all these crystals it increases initially with load for all orientation and for all quenching temperatures, reaches a maximum value at certain load, then gradually decreases with increasing loads and attains almost a constant value for all higher loads.

8) Indentation studies of cleavage faces of quenched specimens of NaCl, KCl and KBr have clearly shown that the anisotropic constants a_1, a_2 and b_2 are related with quenching temperature T_q by the equation

$$g\, T_q^{1-m} = Cr.$$

where g can be a_1, b_1 or b_2.

9) Graphical study of actual observation of p and d for the cleavage faces of these crystals, instead of studying by applying kick's law or modified kick's law has shown that the variation of p with d follows the relation,

$$p = e_o + e_1 d + e_2 d^2$$

10) The plot of p/d^2 Vs. $1/d$ has shown the existence of intermediate load region.

11) The comparison of the values of a_2 and b_2 with e_2 values revealed that e_2 values are almost of the same order as those of a_2 and b_2.

12) The a_2 and b_2 values should be considered as anisotropic constants dependant on direction and temperature and the extremum values along [110] direction is independent of direction and temperature.

13) Comparative study of indented cleavage faces of NaCl, KCl and KBr has clearly indicated that the plasticity of KBr is maximum whereas NaCl is minimum.

14) For all these crystal cleavages

$H_A T_q^{K_A} = C_A$ for all indentor orientation A and applied loads in HLR where hardness is constant and independent of load. K_A and C_A change with crystalline anisotropy.

15) The relation between longer diagonal of knoop indentation mark d_{Ar} corresponding to different applied loads p_r in the high load region and quenching temperature T_q and orientation A of the indentor is given by

$$d_{Ar} T_q^{K_A/2} = \sqrt{\frac{14230\, p_r}{C_A}}$$

16) The simultaneous variation of $\bar{H}$ with orientation A

and quenching temperature T_q follows the relation

$$\bar{H} \; A \; T_q^{\,P} = \text{Constant.}$$

17) Plots between $\sqrt{\bar{H} \; A}$ and A are observed to be straight lines. The slope and intercept are related to minimum values of $\bar{H}$ and A. Excellent correlation between the calculated values of slope and intercept from the actual plot and statistically determined values is obtained.

18) An attempt is made to correlate the hardness formula with modified kick's law. The emperical relations developed for hardness studies could successfully be applied for modified kick's law.

19) For the first time the relation is developed and is as follows

$$b_2 T_q^{\,k'} = Cr_3$$

$$b_2 A T_q^{\,p'} = C_3^{\,2}$$

20) Chemical dissolution study on the cleavage faces of NaCl, KCl and KBr has quantitatively correlated the dislocation etch pits and their motions, the dimensions of rosette pattern with microhardness values of these crystals.

FUTURE PLAN OF WORK

There is not a single theory on hardness which could explain satisfactorily the entire spectrum of mechanical properties associated with hardness. Hence a modern theory explaining the mechanical properties should be developed. The indentation figures generate a large number of dislocations in the crystal, however there is not a single relation satisfactorily explaining hardness and the dislocations generated. This also should be theoretically explored. Etch technique is considered to be simple and powerful technique for studying quantitatively all old dislocations in the as-grown crystals and the new dislocations created by indentation. However, the present study has exposed its limitations, hence conjointly a better surface technique should be used to study the above features along with the etch technique.