INTRODUCTION

It is well known that properties of solids under the effect of high pressure and high temperature provide valuable information for understanding the thermodynamic behavior, the equation of state, and the thermoplastic properties. Experimental studies conducted so far; have not been able to attain the extreme pressure and temperature conditions that exist in the earth’s lower mantle.

Thus theoretical studies play an important role in advancing our knowledge of high pressure and temperature physics of solids. Such studies involve the use of various thermodynamic relations and approximations regarding the variation of thermal expansion coefficient, bulk modulus, Anderson-Gruneisen parameter and the other related parameters with pressure and temperature. Reliable values of these quantities have been measured experimentally at room-temperature and atmospheric pressure. However, considerable uncertainties exist regarding their variation under high pressure and temperature.

In the present work, we have made a comprehensive study of the various thermodynamic relations, critically analyzing their validity and applicability to Alkali halide crystals. A thermodynamic relation involving pressure, volume, and temperature is often quoted as an equation of state. The high pressure equation of state has been a subject of wide investigations made by Bridgman and others. Among various phenomenological equations proposed so far, the two most widely used equations are Murnaghan and Birch equation of state. We shall make use of both the equations of state to predict P-V data at room-temperature of halides (Na, Li, and CsCl) and compare the results with the experimental data to judge reliability. Freund and Ingalls have suggested the need of adopting alternative methods for determining it we shall make use of interionic potential model with inverse-power form and exponential form of potential function to evaluate .

The high pressure behavior of various solids can only be well understood if we have data on the bulk modulus as a function of pressure. In principle, the isothermal bulk modulus can be determined from an isothermal equation of state representing the relationship between pressure and volume at a fixed temperature. We, therefore, select a number of equations of state most widely used and frequently reported in the recent literature and shall make use of them to find corresponding relevant expressions for the pressure dependence of the bulk modulus.
The recent past has witnessed a considerable and growing interest in the study of pressure dependence of thermal expansivity of various solids both by experimental and theoretical methods. However, uncertainty exists in the experimental results obtained so far. Thus, there is still a need of developing accurate theoretical equations to provide insight into the high pressure behavior of solids.

In order to study the equation of state and thermodynamic properties at simultaneously elevated pressure and temperature, we have to introduce certain modifications in Murnaghan and Birch’s equation of state. This can be achieved following the work of Plymate and Stout who has incorporated a factor for thermal effect in the Murnaghan assumption for bulk modulus. The equation of state thus developed shall be used to calculate $P-V-T$ and $\alpha(T, P)$.

Some phenomenological models to understand the thermo elastic behaviour of solids have been developed by various workers to study this. Yamamoto et al. have measured the elastic constants, bulk modulus, and thermal expansivity for NaCl Crystal in the temperature range 298-766 K. We shall investigate the temperature and pressure dependence of compression ratio ($V/V_0$), Bulk modules ($K$) and thermal pressure dependence of a expansivity by using Tallon’s model and shall comparise the results with those from Tait’s equation, Fei-Saxena EOS., Kumar model and Raju et. al. models and available experimental data for 17 alkali halide crystals.