CHAPTER II

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Modern chemical industries, by virtue of their basic structure, as well as due to the modes of their processes, have to use plenty of water from natural resources, for cooling purposes. It is well known that 'water' is just not H_2O in common sense, since, while as a compound it undoubtedly bears the chemical formula H_2O, it has dissolved impurities of a number of other substances and hence it assumes the nature of 'solution'. The impurities contained differ not only in their chemical constitution but also in their concentration, and may be called as 'solutes' without confusing the two terms. The basic nature of the 'common' water is that of a solution rather than of a pure compound and as such has varied effects on materials that come in its contact.

Several physical properties of 'water' will undergo modifications based on its impurities. When such 'solution-water' is used as 'solvent', the properties undergo further modifications. In chemical industries, the three major uses of water solution are : (i) Solvent (ii) Cooling medium and (iii) Steam raising. All these three major uses get wonderfully affected because of the impurities present in natural waters.

While the uses (i) and (iii) face varied problems of wide range, that of the use (ii) has problems quite typical in nature and their solution may not find much common ground with (i) and (iii). It thus becomes imperative to examine the problems of cooling waters from the proper perspective, though at first sight there may appear sufficient resumblance with those of the use (iii). One obvious difference is that of 'boiling' in one case and 'cooling' in the other, and though 'scaling' and 'corrosion' may seem not much differing from a layman's angle, the chemical effects do differ warranting different treatment.

The major problems faced in cooling systems are (i) scaling (ii) corrosion (iii) fouling and (iv) microbiological growth. Scaling is never that severe in cooling waters as experienced in steam raising waters and fouling may not find much place in the boiler system though it may cause some problems at the heat exchangers. In other words, in terms of both 'intensity' and 'extensiveness' of the major difficulties experienced in the cooling waters, the treatment warrants a quite exclusive approach and remedy.

The study of the characteristics of cooling waters used for ammonia and other plants and its remedial aspects with the view of obtaining the optimum efficiency while reducing the general corrosion-degradation of the metals coming in its contact form the general theme of this investigation, since, far from being anywhere near perfection in terms of its use as cooling waters, the very nature of the problems arising and the mode of treatment are much less understood and appreciated. A systematic study incorporating as many facets as relevant in a major sense, could shed better light that may have benign impact. Needless to emphasize that the proposed study is so aimed as to achieve academic understanding and perfection in analysing the facts of the cooling water problems and to explore utilitarian system of treatment that may pave the path of obtaining industrial economy and lessening the embarrassing conditions in the availability and discharge of cooling waters without any restrictions.

The object of this investigation may be formulated, with this broad perspective in view, as consisting of several distinct steps:

1. Firstly, the cooling waters of several plants such as (i) Ammonia (ii) Urea (iii) Ammonium sulphate (iv) Caprolactam (v) Makeup may be fully analysed for physico-chemical properties and total solid contents, over a period of time. This will reveal the nature of the cooling water with regard to pH, conductivity, total dissolved solids, phenolphthelin alkalinity, methyl orange alkalinity, total alkalinity total hardness, calcium hardness, chloride, phosphate, ammonical nitrogen, total nitrogen, turbidity, nitrate etc., Utilization of these physico-chemical parameters will be towards a comprehensive understanding

and appreciation of their general behaviour as cooling waters.

2. Secondly, it is aimed to select some of the products which have been prescribed as additives to the cooling waters, and to carry out at varying concentrations, pH, fraction of time etc., experimentations for evaluating their impact on the extent of corrosion or general degradation of the metals the waters come in contact with, and assess the corrosion rate and inhibiting efficiency with respect to the blank water.

3. While the above two steps would find their study location in the chemical laboratory, the third important object of this investigation is to carry out experimentation in the same varying conditions and factors, with the arrangement of cooling water loops at some of the plant sites, in absence of heat transfer system. This kind of study will provide, it is hoped, a comparative picture of corrosivity, fouling, scaling and pitting, with respect to actual cooling waters whibh have been treated by additives, and makeup water. Thus a system of a assessing the effect at the stagnant waters in contrast to flowing waters will too be available.

4. Foourthly, again at laboratory level, with similar variations of conditions and factors, the effect of

one of the additives selected, at the highest effective concentration, it is aimed to study the effect of surface treatment.

5. Lastly, but not in the least, it is proposed to make a thorough assessment of all the comparative results and to evolve system of evaluation and generalization. In other words, the attempt will be to correlate the various factors and generalize conclusions.

The study is expected to throw good light, since such detailed studies seem to be not that frequently undertaken; it is also expected to generalize optimum conditions for cooling water additives in respect of the chemical, constitutional, physical and the like aspects of the additive materials.