SYNOPSIS

STUDIES IN THE UTILIZATION OF INDIAN RAW MATERIALS FOR THE MANUFACTURE OF SYNTHETIC RESINS.

The present thesis consists of two main parts. Part I deals with the studies on the Utilization of by-product tar from Producer Gas plants for the manufacture of thermosetting resins suitable for the moulding industry. Part II deals with the studies on the Utilization of naturally occurring resinols for the production of synthetic resins suitable for the coating industry.

Part I, Chapter I: Part I consists of eight chapters. In chapter I the formation of by-product tar in the Producer Gas plants during gasification of hardwood is described. There is a very great difference in the formation of tar during gasification of wood and destructive distillation of wood and this has been clearly demonstrated in this chapter.

Part I, Chapter II: This chapter deals with the extraction of dissolved phenolic bodies in wash waters of Producer Gas plants. During gasification of wood in Producer Gas plants part of the low boiling phenols get dissolved in the wash water that is employed to wash the Producer Gas. Studies on the solvent extraction, using different solvents, of dissolved phenols from the wash water are detailed in this chapter. It has been found that neutral oils obtained during distillation of by-product tar can be employed for the extraction of dissolved phenols from the wash waters. By
adopting this method the process becomes economic. A comparative study on the extraction coefficients of benzene butyl acetate and neutral oils is given.

**Part I, Chapter III:** This chapter deals with demulsification of by-product tar. The by-product tar is in the form of an emulsion containing 40-60% of water. Studies on demulsification and dehydration of by-product tar using chemical agents and also heat and pressure are reported in this chapter. Demulsification of by-product tar is the first step in the utilization of the same for the production of synthetic resins. Demulsification helps in the distillation of tar by reducing fuel consumption and avoiding frothing during distillation.

**Part I, Chapter IV:** This chapter deals with the separation of reactive phenolic bodies from by-product tar and their identification. The phenolic bodies have been separated by solvent extraction, steam distillation and direct distillation. The composition of distillates obtained in each case was separately investigated. On detailed investigation it has been found that by-product tar on distillation yields a fraction boiling between 180-230°C consisting mostly reactive poly-functional phenols like phenol, m-cresol, o & p-cresols, m-ethyl phenol, 1;3;5 xylenol and 1;3;4 xylenol.

**Part I, Chapter V:** This chapter deals with the resinification of reactive phenols with different aldehydes in the presence of different catalysts. The kinetics of
resinification of mixed phenols present in by-product tar have been studied. A synthetic mixture consisting of the main constituents of the reactive phenol fraction (b.p.180-230°C) in by-product tar has been made from pure chemicals, and the kinetics of resinification of the same with aldehydes were studied for comparison. Detailed investigations have shown that the phenolic fraction boiling between 180-230°C yields thermosetting resins suitable for the moulding industry. Optimum conditions for resinification have been established.

**Part I, Chapter VI:** This chapter deals with the preparation of moulding powder from resins made from the reactive phenol fraction obtained from by-product tar. Detailed investigations that have been carried out on the characteristics of the mouldings obtained from the above mentioned moulding powder are also reported in this chapter. Among the characteristics that have been investigated are flexural strength, tensile strength, impact strength, water absorption and insulation resistance. The effect of different fillers and the ratio of resin to fillers has also been investigated. Ammonia catalysed resin is found to be most suitable for the preparation of moulding powder of good quality. The moulded articles conforms to the specifications laid down by A.S.T.M. standards.

**Part I, Chapter VII:** This chapter deals with the thermal cracking of high boiling fraction (above 250°C) obtained during distillation of by-product tar. Thermal cracking of high boiling fraction has been done to convert
it to reactive low boiling phenolic fraction. The high boiling fraction consists mostly phenols and their ethers.

Part I, Chapter VIII: This chapter deals with pilot plant investigations on distillation of by-product fractionation of the distillate, and resinification of the reactive phenols to yield thermosetting resins. The layout of 1 ton moulding powder per day plant is given in this chapter. The economics of the process has also been worked out, based on the data obtained during pilot plant investigations.

Part II, Chapter I: Part II deals with the polymerization and co-polymerization of naturally occurring resinols viz., Bhilawa shell liquid and Cashew shell liquid. In chapter I a brief review of addition polymerization has been made. This has been done to provide a necessary background for the polymerization of resinols.

Part II, Chapter II: This chapter deals with the mechanism of polymerization of Bhilawa shell liquid. The volatiles that are liberated during thermal polymerization of Bhilawa shell liquid have been condensed and analysed. They consist mostly of unsaturated hydrocarbons and phenols. The kinetics of polymerization were followed by viscosity measurements, iodine values, maleic anhydride values and molecular weight determination. From the results obtained it may be concluded that Bhilawa shell liquid polymerization is essentially dimerisation taking place by diene synthesis.
Part II, Chapter III: This chapter deals with the preparation of four co-polymers of Bhilawa shell liquid. These co-polymers are made with the object of modifying the properties of resin obtained from Bhilawa shell liquid. The modifying agents that have been employed are styrene, maleic anhydride, cashew shell liquid and xylenol (1:3:5). The co-polymers have better hardness, flexibility, impact resistance and adhesion to metals when used as coating resins.

Part II, Chapter IV: This chapter deals with the chemical and physical characteristics of films obtained from co-polymers of Bhilawa shell liquid. The co-polymers have been found to be highly resistant to the action of chemicals like hydrochloric acid, sulphuric acid, sodium chloride and reducing agents. Extensive investigations on the resistance of the film obtained from the above co-polymers have been carried out. These co-polymers can be incorporated in drying oils and the products obtained have been found to be very good air drying and stoving enamels.