CHAPTER I

INTRODUCTION

In the last two decades we saw a major growth in the use of polyurethane as material for construction, insulation, packaging, upholstery and transport applications[1].

Polyurethane are used in the form of lightweight flexible or rigid foams, elastomers, coatings and adhesives for applications in the furniture and bedding, automative, building, refrigeration, textile, coating, footwear, and other market. Rigid polyurethanes, the subject of these studies, are cost effective insulating material, which are used increasingly in construction applications, such as domestic cavity walls, to reduce energy costs.

The fire hazards of polyurethane foams have been well documented. In addition to their flammability, there is much concern about the emission of large amounts of smoke and toxic gases, particularly carbon monoxide and hydrogen cyanide from these polymers and consequently there is considerable interest in developing novel fire retardants for use in their materials. In general, the main additives, which are in current usage as fire retardants for polyurethane foams, are derivatives of chlorine, bromine and phosphorus. Dimethoxymethyl phosphate (DMMP) is widely used commercially as a flame retardant in polyurethane foams. But its major disadvantage is the smokiness which treated foams burn [2,3]. Thus there has been considerable interest in finding new and safer additives as flame and smoke retardants in polyurethane.

In 1980, inorganic tin compounds were found to be effective fire retardants in a number of natural and synthetic polymers [4-11]. They appear to have certain adventages over the existing commercial additives, namely :

non-toxicity,

effectiveness at low incorporation levels,

no discolouration of substrate,

marked flame-retardant synergism with halogen,

little apparent effect on physical properties,

combined flame retardancy and smoke suppressancy,

wide range of applicability.

In view of these factors, it was suggested that the possible use of tin chemicals as flame retardant and smoke suppressant should merit serious consideration. In addition, studies at International Tin Research Institute (I.T.R.I.) have demonstrated the effectiveness of zinc hydroxystannate and zinc stannate as flame retardant additives for halogen containing polymer formulations.

Therefore, this study was concentrated on the possibile use of tin compounds as fire retardants in polyurethane. The only previous reported work on tin chemicals as fire retardants for polyurethanes, involves the incorporation of either SnO_2 or SnO into flexible chlorinated foams, as partial replacements for Sb_2O_3. When used at a 5% level, along with 10% Sb_2O_3, these tin oxides gave a self-extinguishing foam, comparable in performance to a composition which contained 15% Sb_2O_3 alone. However, neither SnO_2 nor SnO were effective at a level of 15 % without the presence of the antimony compound.

In rigid polyurethanes, preliminary work at I.C.I has indicated that certain oxidic tin additives, supplied by I.T.R.I., show significant smoke suppressant behaviour. However, subsequent research found that these inorganic tin derivatives were poorly dispersed within the foam. From this failure, it was decided to investigate the effect of mono- and di-organotin compounds in fire retardant properties.

The choice is limited by certain factors:

i) The compounds should not be wet, nor should they contain loosely bound water, since isocyanate reacts with water to form CO_2 which affects the normal blowing of the foam.

ii) The tin additives should not be soluble in the polyol, since tin compounds are known to be very active catalysts for polyurethane formation and would therefore greatly reduce processing times.

iii) The tin salts should form a suspension in the polyol blend so that a homogeneous dispersion of the additive in the foam is attained.