CHAPTER 1 - INTRODUCTION

Polymers play an essential role in everyday life. They have excellent properties that allow them to be used in many applications, such as electrical insulation, tyres, mouldings, films, fibres, and packaging for food. Each year, the demand for polymer increases. It is said that the market share of organic polymeric materials may exceed 50% of the total materials consumed in the 21st century [1].

Polyethylene (PE) and polypropylene (PP) are synthetic polymers with large annual sales volumes. The typical life cycle of PE and PP as synthetic polymers is [2]: synthesis, compounding, conversion and/or processing, usage, disposal or recovery and re-usage. Because of their relatively low cost, polyolefins (PE and PP) are widely used. However they are difficult to stabilise. Improvements in the exterior durability of polyethylene and polypropylene are desirable in external applications, e.g. green house film [3, 4, 5, 6]. Most polymers are susceptible to ultraviolet radiation in the 290-400 nm region. The absorption of this energy causes the chemical bonds in macromolecular chains to break. This in turn results in embrittlement, surface crazing, chalking, discoloration and loss of impact and tensile strength. The number and nature of light-absorbing groups in a polymeric system are important factors in photodegradation; in polymers that have no chromophores, impurities induce degradation [1-18].

Plastic shopping bags have become an integral part of the South African life-style. Most retailers supply them free of charge to their customers. Unfortunately, progress in film blowing and resin technology have made it possible to produce bags that are so thin that post-consumer recycling became impractical. Furthermore, the public is not yet sensitised with respect to environmental issues. Littering is therefore a major problem. The possible solution can be fast degradation under UV but good heat stability so that they can still be recycled.

Photodegradation can aid rapid disintegration of polymers into a powdery residue with a much-reduced visual impact [7, 11]. It is a strategy used in Israel for controlled mineralisation of mulch films used in agricultural applications. The problem with this approach is that it often precludes subsequent recycling. The photodegradants, once activated, also cause degradation during reprocessing.

On the other hand, outdoor use of polymeric materials often is practical only when 0.1-1% of UV stabilisers are added in order to postpone the inevitable effect of light (e.g. carbon black)[3]. These additives are believed to impart stability by absorbing UV radiation, by scavenging free radicals, by quenching excited states and free radical species, or by combinations of these processes. Over years, there have been many publications concerning the efficiency of particular UV stabilisers and prodegradants in term of their compatibility, solubility, volatility and diffusion in the polymer, UV absorption and UV screening [18 - 23].

The aim of this work is to study the efficiency of polyester-based polymeric UV stabilisers and metal-based prodegradants for polyethylene and polypropylene films under UV radiation. Both UV stabilisers and UV prodegradants were considered. The compounds investigated included various metal complexes as well as substituted hindered amines with available alcohol functionality. With respect to the hindered amines, derivatives with higher molecular mass were prepared using esterification and transesterification reactions to increase the effective molecular mass, to reduce the inherent volatility of the basic hindered amines and to improve the compatibility of very polar hindered amines with the non polar polyolefin matrix. Alkyl esters and alkyl polyesters were chosen because of their relatively low polarity and their ease of synthesis.