

174356
D
19/07/2004

L. 3000/

An Investigation to Solve the Existing Problem of Undesirable Odours in Polyethylene Films

By

Asela Chandrasoma

174356

This thesis was submitted in partial fulfillment of the requirement for the Master's Degree of Science in Polymer Science and Technology for the University of Sri Jayawardanapura, Sri Lanka.

December 2003

ABSTRACT

Odor formation in polyethylene packaging films has become a serious problem in the polymer packaging industry. The characteristic odors such as musty, stale, rancid, burnt wax and sweet odors have been experienced in PE packaging films.

High temperature encountered during the manufacturing process may induce thermal decomposition products that can migrate to the surface of the film and cause undesirable odors. High shear forces encountered during the manufacturing process leads to break down of molecules and formation of odor species which cause odor problems. Use of worn off screws and barrels also enhance the effect by increasing the dwell time of the molecules due to back flow.

The main objective behind this research is to find out the odorous chemicals in the PE packaging films. GC, FT – IR and GC/MS techniques were used for chemical analysis. Initially GC was used to find the specific chemicals present in the odorous sample, but this attempt only led to a vague identification between odor sample and odor free sample. Then the FT – IR was used for the analysis. This provided details about some kind of formation of aldehyde carbonyl in odor sample. This carbonyl is also present in odor free samples but the concentration is not that significant.

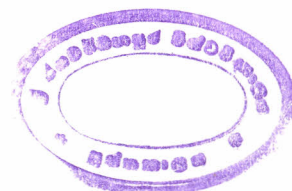
GC/MS was used to further analyze the samples. In GC/MS, it is found that nonanal (C – 9 aldehyde) is present in both samples but high concentration in odor samples and low concentration in odor free samples.

The odor definition of nonanal is said to be rancid & musty as defined in odor characteristic. It has relatively low molecular weight so that the migration will be faster. The odor threshold level is also very low in nonanal and it is as low as ppb levels. Apart of nonanal, there are some other odorous chemicals such as ketones and esters present in odor samples.

It is found that the reasons for these formations are due to high heat absorption of the processed material due to worn off screws and barrels.

In this thesis this matter is broadly discussed, and root causes for the odor formation are determined. An identification test (Spot test) is developed to determine the odor in the factory floor. Finally it can be clearly seen that the formation of odors is mainly due to use of worn off screws and barrels in extruders. High temperatures, screw speeds and dwell time accompanied with them enhance the problem.

CONTENTS		Page No
	Acknowledgment	01
	Abstract	02
1.	Chapter One – Introduction and Literature review	05
	1.0 Introduction	05
	1.1 Historical Perspective	05
	1.2 Historical Background of the Problem	09
	1.3 Approach towards the problem	10
	1.4 Method of sampling	13
2.	Chapter Two – Experimental	14
	2.1 GC Analysis	14
	2.1.1 Preparation of sample for GC analysis	14
	2.1.2 CG Conditions	14
	2.2 FT – IR Analysis	15
	2.2.1 Preparation of Extract for FT-IR	15
	2.2.2 Quantitative analysis of amide in FTIR	15
	2.3 GC / MS Analysis	16
	2.3.1 Preparation of sample for GC/MS analysis	16
	2.3.2 CG/MS Condition	16
	2.3.3 Analysis done by Micro Analytics (Texas, USA)	17
	2.3.4 GC/MS Conditions	17
	2.4 Scanning Electron Microscope Analysis	17
	2.4.1 Instrument & Conditions	17
	2.5 Weathering Test	18
	2.5.1 Test Conditions	18
	2.5.2 Processing conditions	19



2.6	Identification Test (Spot Test)	20
2.6.1	Methodology	20
2.6.2	Test Conditions and the Oven Parameters	21
3.0	Chapter Three - Results and Discussion	22
3.1	GC Results	23
3.2	FT-IR Results	28
3.2.1	Bands corresponds to the PE wax	28
3.2.2	Calculate the absorbance of the bands	38
3.2.3	Color of the PE wax	42
3.3	GC/MS Results	44
3.3.1	GC/MS results done at ITI	44
3.3.2	GC/MS results done by Microanalytics	47
3.3	Results of Scanning Electron Microscopic Images of Odor and Odor-Free Samples	56
3.4	Weathering Test Results	59
3.5	Results of the Identification Test (Spot Test)	63
3.6	Conclusion	64
3.7	References	65
3.8	Appendix	67