

**DETERMINATION OF CHEMICAL COMPOSITION  
OF  
OXO-BIO DEGRADATIVE MATERIAL  
(PDQ-H)**

**BY**

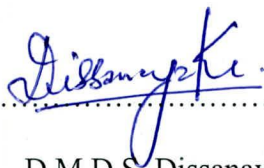
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This thesis was submitted in partial fulfillment of the requirements for the Master Science in polymer Science and Technology to the Faculty of Graduate Studies of the University of Sri Jayewardenepura, Sri Lanka.

Date of Submission: 4<sup>th</sup> of October 2007.

## Declaration

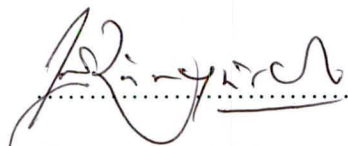
The work described in this thesis was carried out by the under the supervision of Dr. Sudantha Liyanage and Mr. Mervyn Dias and a report on this has not been submitted to any University for another degree. Also I certify that this thesis dose not include, without acknowledgement, any material previously submitted for a degree in any university and to best of my knowledge and belief it dose not contain any material previously published, written or oral communicated by another person except where due reference is made in the text.



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We certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the University for the purpose of evaluation



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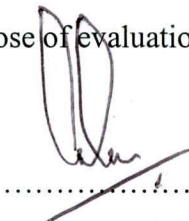
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## ACKNOWLEDGEMENT

I owe my sincerely appreciation and deepest gratitude to my supervisor Dr.Sudantha Liyanage, Senior lecturer of the Department of Chemistry, at the same time Mr. Mervyn Dias (MBA Leicester), chairman of Plastic Packaging (pte) Ltd for the immense encouragement, guidance, and support given through out the research to succeed this event.

I extended my gratitude to Dr. Laleen Karunanayake who is the coordinator of the Master degree program, Polymer Science and Technology, for providing me laboratory facilities in the department and I would like to thank to all academic staff members of the Department of Chemistry who encouraged and guided me.

I am very grateful to Mr. Sagara who gave great exposure me to doing analysis through that period especially when using instruments such as FTIR and UV analysis. At the same I am very grateful to junior academic staff members; they help me in various ways.

I also extend my gratitude Dr. Janitha Liyanage who is the senior lecture of department of chemistry, university of Kelaniya for providing permission to me to conduct my analysis in university of Kelaniya, at the same time I like to convey my gratitude to Dr. K.A.S. Pathirathna who is the department head, department of chemistry, university of Kelaniya providing me instrumental facilities such as AAS etc without any hesitate.

Next I like to convey my gratitude to Mr. Palitha who is the NMR technician in University of Peradeniya provided me lot of information regarding to succeed my analysis.

In this moment I like to present curtesy to Professor Peter Edward who help me in crucial moment in various ways. Next my special thanks go to Mr. Sathya who did great job for me.

I convey my heartiest gratitude to my loving parents; actually they did great help for me in every respect. Also I like to convey my gratitude to my sister, brother and colleagues giving me greater courage and help during my research period. Thank you for every one who encourage me for this task and who wish my progress.....

## ABSTRACT

Degradable polymers (especially Polyethylene Packages) are designed to degrade in different ways and in different environments. There are many different types of degradable plastics being introduced into the Sri Lankan market, resulting in confusion about their impacts and benefits. An important distinction needs to be made **oxo-biodegradable plastics**, which oxidize and embrittle in the environment and erode under the influence of ultraviolet (UV) light and heat.

The impacts of degradable polymers at end-of-life depend on the characteristics of the polymer itself (i.e. what the polymer is made from and how it is designed to degrade), the thickness and surface area of the product, as well as the disposal environment. **There are insufficient data to say with any certainty, how long many degradable polymers take to fully biodegrade, and the impacts of any end products in the environment<sup>5</sup>.**

Oxo-biodegradable polymers (with prodegradant additives such as PDQ-H) are designed to break down under the influence of heat and UV light. Final biodegradation takes place through the action of microorganisms, although there still appears to be some uncertainty about the time needed to fully degrade (particularly whether it can occur within the normal commercial composting period) and the environmental impacts of plastic fragments and additives. The use of oxo-biodegradable polymers for products that are designed for disposal in landfill will result in a loss of resources as the products will not be recovered through either composting or recycling, and will have very little impact on the quantity of waste to landfill or the life of landfills.

Willow Ridge supplies a photodegradable master-batch designated UV-H that accelerates UV degradation by creating free radicals that sever the polymer chains into smaller fragments that can be consumed by microbes. UV-H costs \$1.50/lb and is typically used at a 2% level. It can be combined into a triple-acting system with PDQ, called PDQ-H (Leaversuch 2002). Willow Ridge's additives are effective alone or in synergistic blends of additives that exploit different degradation mechanisms.

Through this project, it was tried to identify the functional groups, carbon skeleton, and availability of conjugation and propose the suitable and critical structure for the PDQ-H and by using it propose the degradation mechanism. For achieved that target FTIR, UV Spectrophotometer, HNMR, <sup>13</sup>C NMR, COSY, DEPT and AAS instrument were used.

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## ACRONYMS

HDPE	high density polyethylene
LDPE	low-density polyethylene
LLDPE	linear low density polyethylene
VLDPE	very low density polyethylene
mLLDPE	metallocene-catalysed linear low density polyethylene
$\lambda$	wavelength
$\mu$	micron
$\nu$	Frequency
$c$	speed of the light
$E$	energy
$h$	plank's constant
$\tilde{\nu}$	wave number
$I_s$	intensity of the sample beam
$I_r$	intensity of the reference beam
UV	ultra violet region
Vis	visible region
$\Delta E$	energy gap or energy difference
PDQ-H	prodegrant
$\Sigma$	$\sigma$ -orbitals, those which correspond to $\sigma$ -bonds

$\pi$	$\pi$ -orbitals, those which correspond to $\pi$ -bonds
N	none-bonding or n-orbitals
$\sigma^*$	anti bonding $\sigma$ -orbitals
$\pi^*$	anti bonding $\pi$ -orbitals
$V_n$	vibrational energy levels
$I_0$	intensity of the incident light
I	intensity of the leaving light
C	molar concentrate of solute
$\epsilon$	molar absorptivity
$I$	spin quantum number
$\mu$	magnetic moment
$\mu_0$	applied magnetic Field
TMS	tetramethylsilane, $(\text{CH}_3)_4\text{Si}$
NMR	Nuclear Magnetic Resonance
RF	radiofrequency
J	coupling constant
$^{13}\text{C}$	carbon thirteen isotope
R	alkyl Group
FT-IR	fourier transform infrared
FT-NMR	fourier transform Nuclear Magnetic Resonance
DEPT	distortionless enhancement of polarization transfer
2D	two dimension