

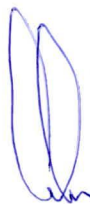
**MIGRATION OF SOME SMALL MOLECULES RESIDING  
IN PLASTIC PACKAGING MATERIALS INTO FOOD AND  
LEACHING OF SOME ADDITIVES FROM EXAMINATION  
GLOVES INTO DISTILLED WATER**

**BM**

**Mahinda Kusumsiri Senevirathne**

**M.Sc**

**2007**



17/07/07

Dr. Laleen Karunanayake

Senior Lecturer

Department of Cner-kv

University of Sri Jayawardanapura.

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**BY**

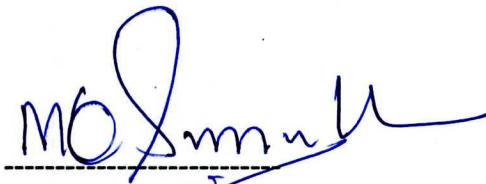
**Mahinda Kusumsiri Senevirathne**

**A dissertation submitted in partial fulfillment for the Degree of Master of  
Science in Polymer Science and Technology in the Faculty of Graduate  
Studies**

**Department of Chemistry  
University of Sri Jayewardenepura  
Sri Lanka  
2007**

## DECLARATION BY THE CANDIDATE

The work described in this thesis was carried out by me under the supervision of Dr Jagath Premachandra (Department of Chemical Engineering, University of Moratuwa) and report on this has not been submitted in whole or in part to any university or any other institution for another Degree/Diploma.

A handwritten signature in blue ink, appearing to read 'H.P.M.K. Senevirathne', written over a horizontal dashed line.

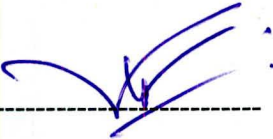
H.P.M.K Senevirathne

17.07.2007

Date

## DECLARATION OF THE SUPERVISOR

I 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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Dr Jagath Premachandra

2007.07.17

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Date

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## Abbreviations

|      |                                     |
|------|-------------------------------------|
| PET  | Polyethylene Terephthalate          |
| HIPS | High Impact Polystyrene             |
| NR   | Natural Rubber                      |
| ZMBT | Zinc Salt of 2-Mercaptobezothiazole |
| ZDEC | Zinc Diethyldithiocarbamate         |
| LDPE | Low Density Polyethylene            |
| DNPH | Dinitrophenyl Hydrazine             |
| EV   | Efficient Vulcanization             |
| SEV  | Semi Efficient Vulcanization        |
| CV   | Conventional Vulcanization          |
| TPA  | Teriphthalic Acid                   |
| DMT  | Dimethyl Terephthalate              |
| EG   | Ethylene Glycol                     |

## **Abstract**

Polyethylene, terephthalate (PET) bottles, high impact polystyrene (HIPS) cups and latex chlorinated examination gloves are commonly used in plastics and rubber industry. During the production process of PET bottles, acetaldehyde is produced as a by-product. Unreacted styrene monomer and rubber additives could be present in the final products of HIPS cups and chlorinated examination gloves. Contents could be contaminated due to migration of these by-products.

Migration of acetaldehyde from freshly blown PET bottles into distilled water at different temperatures and migration of acetaldehyde from used PET bottle into coconut oil with the increasing storage time were examined using UV Visible spectrometer. Migrated unreacted styrene monomer from HIPS cups into distilled water at different temperatures was tested using gas chromatography with flame ionization detector (GC-FID). Migration of rubber additives from chlorinated examination gloves into distilled water with increasing shelf time was analyzed using FTIR spectrometer.

At 20°C, 2.6 ppm was the concentration of migrated acetaldehyde from freshly blown PET bottle into distilled water. Migration of acetaldehyde increased up to 4.5 ppm with the increasing of temperature. Concentration became constant at 35°C and it remained constant even at higher temperatures. Acetaldehyde migration had not occurred from used PET bottle into coconut oil. Trace amount of migrated styrene monomer from HIPS cup into distilled water was detected at elevated temperature and the result revealed that no migration of rubber additives had occurred from chlorinated examination gloves into distilled water.

# 1 INTRODUCTION AND LITERATURE REVIEW

Since the last two decades or so, the packaging industry has developed in leaps and bounce, due to the new technology and the discovery of plastics. Usage of plastics for packaging industry has lot of advantages over the predecessor such as glass, metal and paper. Obvious reasons are breakages in glass and corrosion in metals.

The flexible properties of plastics have added on to the advantages that plastics on its own possessed, i.e. injection molding, films, lunch sheets and grocery bags blow molding and so on. However, further improvements are been researched to preserve the freshness in food items.

Out of the plastics, known polyethylene terephthalate (PET) is the most commonly and widely used, as it has so many advantages compared with other plastics. PET bottles are used to store beverages, mineral water, vinegar, alcohol and so on. In developing countries such as Sri-Lanka, these bottles are reused for domestic's purpose (i.e. to store coconut oil). PET is synthesis by polycondensation reaction and there are side reactions in PET preparation. Acetaldehyde is a decomposition product of the poly condensation reaction and is a by-product of melt processing of polyethylene terephthalate<sup>1</sup>.The acetaldehyde in the PET container could migrate in to the contents such as mineral water, coconut oil, etc. Since acetaldehyde is toxic to humans, if such contents are used or consumed, it will result in a health complication<sup>2</sup>. If the migration actually occurs it is important to know migrated acetaldehyde quantitatively and qualitatively

When foodstuff is packed in such containers, the above-mentioned residues could migrate into the consumables. When these consumables are consumed by humans or animals they could end up having health complications.