*Al-Azhar University (Girls Branch)*
*Faculty of Science*
*Chemistry Department*

# *Improvement of Physico-Chemical Properties of Recycled (Elastomers /Thermoplastics) Composites using Ionizing Radiation*

*A Thesis Submitted by*

***Mona Yusuf Elnaggar Ahmed Ibrahim***

*M Sc. In Chemistry 2010*

***National Center for Radiation Research and Technology***

***Atomic Energy Authority***

***To***

*Chemistry Department*
*Faculty of Science, Al-Azhar University (Girls Branch)*

***In Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Chemistry***

***(2013)***


*Al-Azhar University (Girls branch)*
*Faculty of science*
*Chemistry Department*

# *Improvement of Physico-Chemical Properties of Recycled (Elastomers /Thermoplastics) Composites using Ionizing Radiation*

*A Thesis Submitted by*

***Mona Yusuf Elnaggar Ahmed Ibrahim***

*M. Sc. In Chemistry 2010*

***National Center for Radiation Research and Technology***

***Atomic Energy Authority***

*Faculty of Science, Al-Azhar University (Girls branch)*

***To***

*Chemistry Department*
*Faculty of Science, Al-Azhar University (Girls Branch)*

***For The Fulfillment of the Ph. Degree in Science***

*(2013)*

***Thesis Supervisor***

***Prof. Dr. El-Sayed A. Hegazy***

*Prof. of Radiation Chemistry, former chairman of National Center for Radiation Research and Technology*

***Prof. Dr. Nagwa A. Badawy***

*Prof. of Physical Chemistry, Faculty of Science (Girls), Al-Azhar University*

***Asst .Prof .Dr. Medhat M. Hassan***

*Asst. Prof. of Radiation Chemistry in National Center for Radiation Research & Technology*


## *Approval Sheet*

*Name: Mona Yusuf Elnaggar Ahmed Ibrahim*

*Title of thesis:*

# *Improvement of Physico-Chemical Properties of Recycled (Elastomers /Thermoplastics) Composites using Ionizing Radiation*

***Degree:*** *Ph. Degree, Faculty of Science, Al-Azhar University (Girls Branch), 2013*

***Signature***

***Supervisors***

***Prof. Dr. El-Sayed A. Hegazy***

*Prof. of Radiation Chemistry, former chairman of National Center for Radiation Research and Technology*

***Prof. Dr. Nagwa A. Badawy***

*Prof. of Physical Chemistry, Faculty of Science (Girls), Al-Azhar University*

***Asst .Prof .Dr. Medhat M. Hassan***

*Asst. Prof. of Radiation Chemistry in National Center for Radiation Research and Technology*

*Head of Chemistry department*
*Faculty of Science, Al-Azhar University (Girls Branch)*

***Signature***

*Al-Azhar University (Girls branch)*
*Faculty of science*
*Chemistry Department*

# *Approval sheet*

***Name:*** *Mona Yusuf Elnaggar Ahmed Ibrahim*

***Title of thesis :*** *Improvement of Physico-Chemical Properties of Recycled (Elastomers /Thermoplastics) Composites using Ionizing Radiation*

***Degree:*** *Ph. Degree, Faculty of Science, Al-Azhar University (Girls Branch), 2013*

***Examiner Committee*** ***Signature***

***Prof. Dr. Heshan Fouad Aly***
*Prof. of Nuclear Chemistry, EAEA*

***Prof. Dr. Fatma Hafez Kmal***
*Prof. of Physical Chemistry, Faculty of Science (Girls), Al-Azhar University*

***Prof. Dr. El-Sayed A. Hegazy***
*Prof. of Radiation Chemistry, former chairman of National Center for Radiation Research and Technology*

***Prof. Dr. Nagwa A. Badawy***
*Prof. of Physical Chemistry, Faculty of Science (Girls), Al-Azhar University*

***Prof. Dr. Eman Shokry***

***Head of Chemistry Department***

***Faculty of Science, Al-Azhar University (Girls Branch)***

***Signature***

*Al-Azhar University (Girls Branch)*
*Faculty of Science*
*Chemistry Department*

# *Improvement of Physico-Chemical Properties of Recycled (Elastomers /Thermoplastics) Composites using Ionizing Radiation*

***Plan of work***

1. Attempts of partially devulcanizing the implemented rubber by various ways are intended to be carried out.
2. The materials to be used in this investigation are polymeric virgin and waste of thermoplastics such as PE, PP, PET, PA, in addition to waste rubber.
3. Preparation of blends and composites will be carried out by adding some additives using extruder and compression molding machine.
4. Compatiblizers will be used for stabilizing the developed blends and composite
5. EPDM addition to prepared blends and composites for enhancing the outcome properties.
6. Vulcanizing agents will be tried on the partial waste rubber devulcanizate for acquiring better mechanical characters.
7. Different samples of blend and composite will be exposed to different doses of gamma radiation or electron beam radiation.
8. Characterization of materials will be done by different techniques like IR and XRD, etc.

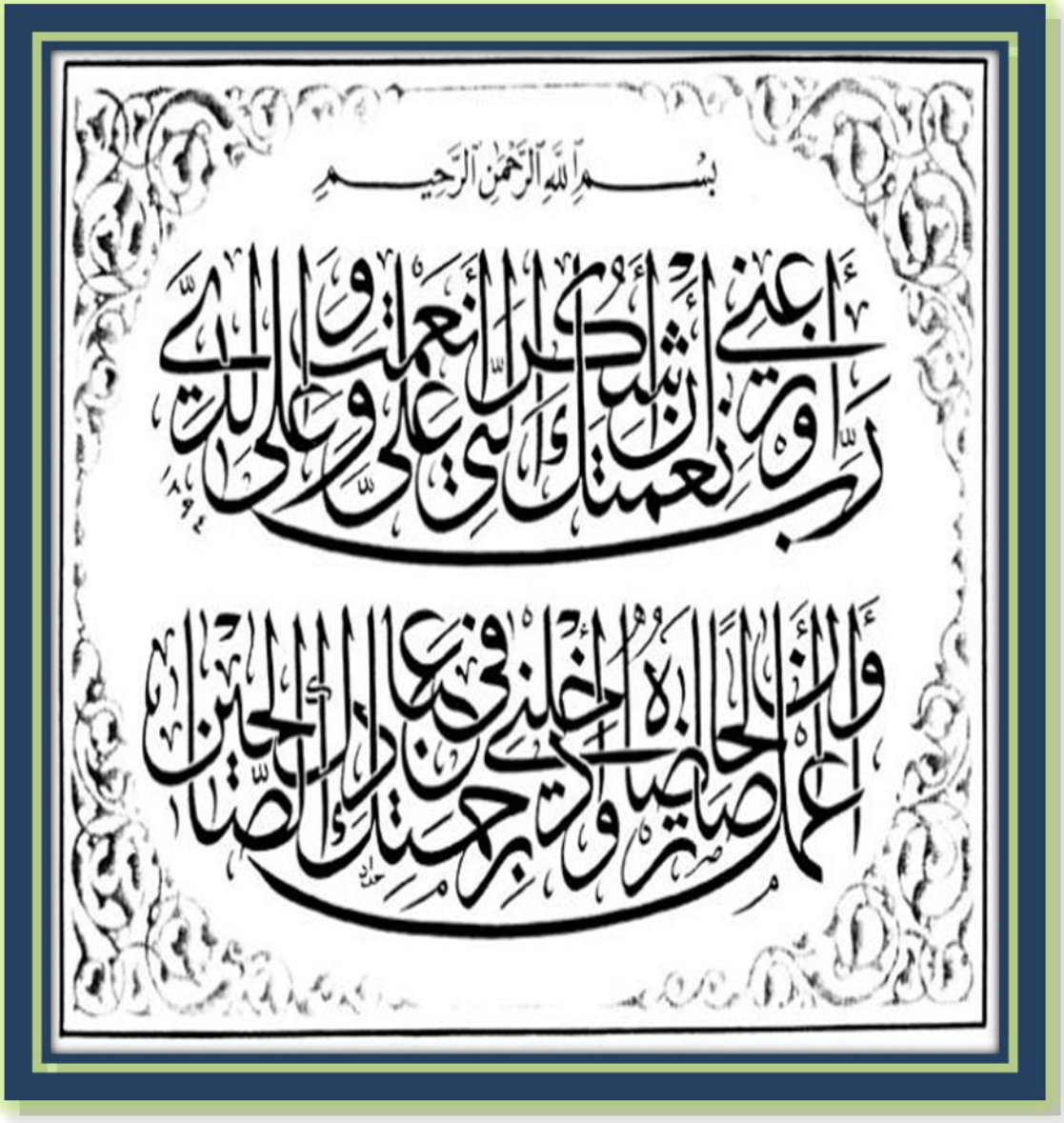
***Supervisors*** ***Signature***

***Prof. Dr. El-Sayed A. Hegazy***
*Prof. of Radiation Chemistry, former chairman of National Center for Radiation Research and Technology*

***Prof. Dr. Nagwa A. Badawy***
*Prof. of Physical Chemistry, Faculty of Science (Girls), Al-Azhar University*

***Asst .Prof .Dr. Medhat M. Hassan***
*Asst. Prof. of Radiation Chemistry in National Center for Radiation Research and Technology*

***Department head*** ***Dean***



PDF-XChange Viewer
Click to buy NOW!
www.docu-track.com

*This Work Is Dedicate*

*To my parents*

*Without Their Support, Endless Help and Continues Encouragement All the Time*

*I Could Never Finish This Work*

*I Am So Proud To Be Your Daughter*

PDF-XChange Viewer Click to buy NOW! www.docu-track.com

# *Acknowledgement*

*First of all, the main thanks to "Allah" to whom I always pray and under the light of his "HOLLY FACE" I live and go.*

*Iwould like to offer my deep thanks to* ***Prof.Dr. El-Sayed A. Hegazy;*** *Prof. Of Radiation Chemistry, former chairman of National Center for Radiation Research and Technology For his continouse guidence, interest, valuable discussion, supervision and advices throughout this work .*

*Also, I am grateful to* ***Prof .Dr. Nagwa A. Badway****; Professor of Physical Chemistry, Faculty of Science (Girls), Al-Azhar University .for her great efforts, honest assistance, supervision and help to have this work done.*

*I would like to express my sincere gratitude and respect to* ***Asst. Prof. Dr. Medhat M. Hassan;*** *Asst. Prof. in National Center for Radiation Research & Technology, for his masterly teaching, valuable advices, honest assistance. wise guidance, kind supervision and continuous encouragement.*

*I wish to express my sincere gratitude to all the members and colleagues in the National Center for Radiation Research & Technology and Faculty of Science (Girls), Al- Azhar University, for their efforts, help and friendship throughout my research.*

PDF-XChange Viewer Click to buy NOW! www.docu-track.com


## *Abstract*

Recycling of ground tire rubber (GRT) not only solves the waste disposal problem and maintains environmental quality, but also saves the valuable and limited resource of fossil feedstock. The major problem in the recycling of rubber-like materials such as tires is the cross linked molecular structure of already vulcanized rubber, which not only prevents the softening and processing of waste rubber particles but also inhibits binding of the powder surface to the virgin material. Several reclamation methods have proposed to overcome these barriers, which have basically followed two main approaches: (1) the devulcanization of cured rubber and (2) the surface modifications of waste particles. The devulcanization of rubber causes the cleavage of crosslinks via chemical treatments, which make used rubber suitable to be reformulated and recurred into new articles. In consequence, this work is mainly aimed to prepare of devulcanized rubber (DR) and evaluating mechanical, thermal, and morphological properties of the thermoplastic vulcanizates (TPVs) based on devulcanized rubber blended with polypropylene, EPDM using peroxide under the effect of radiation dose and DR feed ratio. The efficiency of the compounding process has been examined by infrared spectroscopy (FTIR), X-ray diffraction and scanning electron microscopy (SEM). The mechanical and thermal behaviors of the blends composed of devulcanized rubber (DR) , high crystalline polypropylene (PP) and EPDM in different proportions were studied. Evaluation of the mechanical and thermal properties of the developed blends, unirradiated and gamma irradiated, was carried out using tensile strength (Ts), elongation at break (Eb), hardness, TGA and DSC measurements.



**Keywords: -**

Recycling / ground tire rubber / devulcanization / thermoplastic vulcanizates / gamma radiation /thermal behavior/ mechanical properties

PDF-XChange Viewer Click to buy NOW! www.docu-track.com

## *Aim of work*

Because of the large volumes of scraps associated with rubber production, the old practice of landfilling has been unable to keep up with production because of rising land costs, environmental concerns and fire risks occurring at this site. Considering that vulcanized rubber is not easily biodegradable, recycling methods must be proposed in order to solve this environmental problem and recover a material with high commercial value. The cross-linking of the polymer main chains during the vulcanization process turns the thermoplastic into a thermoset material, which cannot be remolded by simple heating. In order to break down the cross-linked network of vulcanized rubber, some physical or chemical treatment is necessary. The objective of this work is to try to get the new material from this waste be remolded to the formation of heat that can be used in multiple applications. This well be prepared devulcanized rubber (DR) by partially break down the cross-linked network using mechanochemical treatment method. Also; the coupling of DR with PP and EPDM in different proportion was investigated in the presence of peroxide by FTIR, X-ray diffraction and SEM techniques. The mechanical and thermal behaviors of the blends composed of devulcanized rubber (DR) and other materials in different proportions were studied. Evaluation of the mechanical and thermal properties of the developed blends, unirradiated and gamma irradiated, was carried out using tensile strength (Ts), elongation at break (Eb), hardness, TGA and DSC measurements. Possible applications will be evaluated based on mechanical and thermal properties and other characteristics

# *Contents*

PDF-XChange Viewer Click to buy NOW! www.docu-track.com