

*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

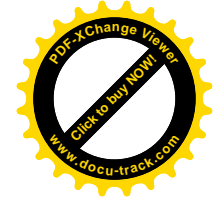
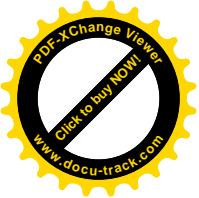
Atomic Energy Authority

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)



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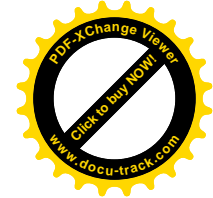
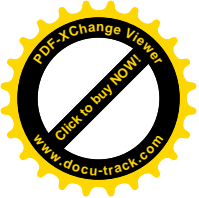
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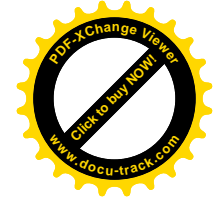
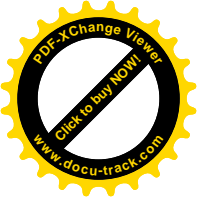
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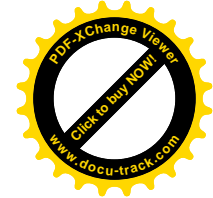
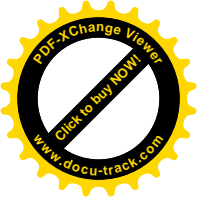
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Improvement of Physico-Chemical Properties of Recycled (Elastomers /Thermoplastics) Composites using Ionizing Radiation

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. Compatibilizers 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

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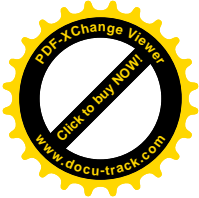
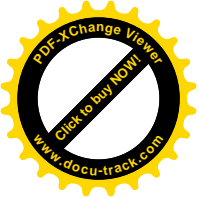
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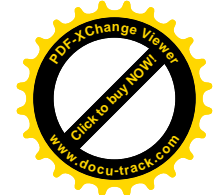
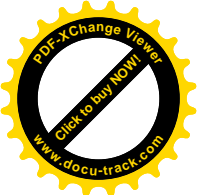
Department head

Dean





*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*



Acknowledgement

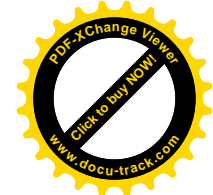
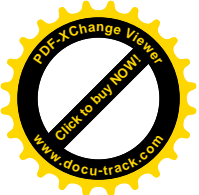
First of all, the main thanks to "Allah" to whom I always pray and under the light of his "HOLLY FACE" I live and go.

*I would 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 guidance, interest, valuable discussion, supervision and advices throughout this work.*

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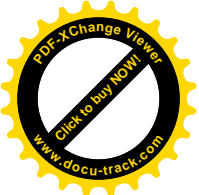


Abstract

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.

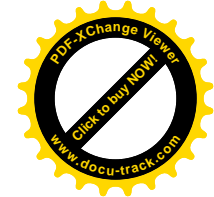
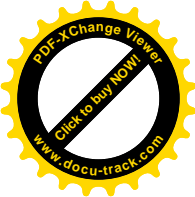
Keywords: -

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



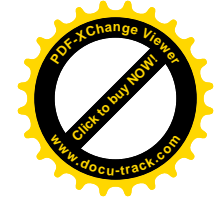
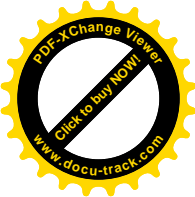
Aim of work

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 will 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



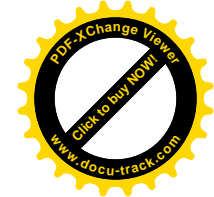
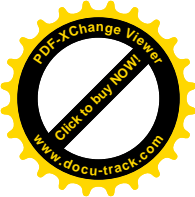
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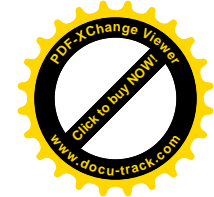
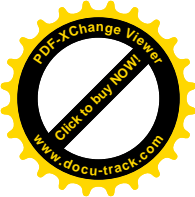
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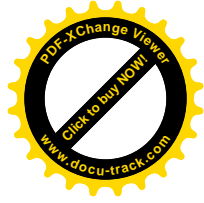
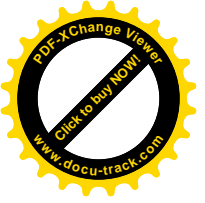
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