STUDIES ON SOME CHEMICAL MODIFICATION OF POLYESTER FIBRES

M. Sc. Thesis

Submitted to

CHEMISTRY DEPARTMENT,
FACULTY OF SCIENCE,
AIN-SHAMS UNIVERSITY

BY

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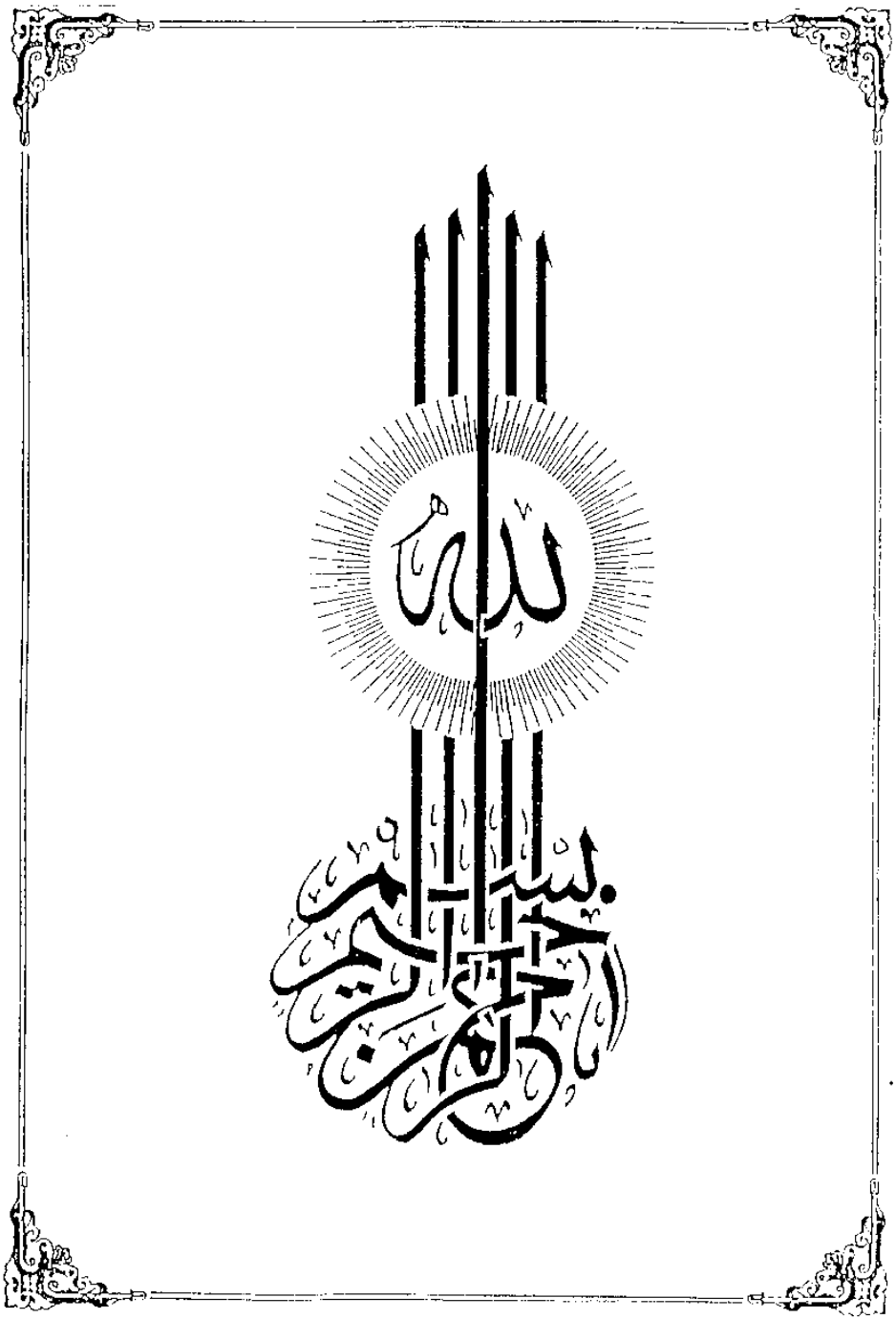

APROVAL SHEET

Title of M.Sc. Thesis

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Name of the Candidate

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AIM OF THE WORK

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The present work aims at creation of epoxy reactive groups in PET macromolecules via a graft copolymerization of polyester fibres with glycidyl methacrylate (GMA) using Fe^{2+}-H_2O_2 as an initiating system. The presence of such groups in the fibres gives them the ability to undergo through consecutive modifications which lead to introducing of basic or acidic groups to the PET fibres and impart to it ion-exchange properties and other desirable properties.

ABSTRACT

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Naser Gad Ahmed. Studies on some chemical modification of polyester fibres. National Research Centre, Textile Research Division. 1996

The present work aims at creation of epoxy reactive groups in poly (ethylene terephthalate) macromolecules (PET) via a graft copolymerization of polyester fibres with glycidylmethacrytate (GMA) using Fe^{+2} - H_2O_2 as initiating system. The presence of such groups in the fibres gives them the ability to undergo through consecutive modifications which lead to introducing of basic or acidic groups to the PET fibres and impart ion-exchange and other desirable properties to it.

The general kinetics of the graft polymerization induced by the above mentioned system were investigated. The rate of grafting has been determined by varying the concentrations of the monomer, hydrogen peroxide and metallic ions. The reaction order was calculated. Raising the reaction temperature from 70 ° C to 85 C° causes a significant enhancement in the rate of grafting; the apparent activation energy was found to be 120.4 KJ / mole.

The effect of polymerization of GMA with PET fibres on some properties of the latter was studied.

Wide angle X-ray scattering was used in investigating the effect of the amount of grafted PGMA on the crystalline and amorphous phase of the polymer. It was found that the unit cell of PET remains, after grafting with PGMA, as a triclinic unit cell with nearly the same interplaner spacings, while peaks intensitives decrease when the amount of grafted PGMA increases. This revealed that the grafting of PGMA onto PET leads only to rearrangement of atoms in the unit cell of the initial material .

Investigation of the electrical properties of the modified PET fibres indicated that, increasing the degree of grafting is not accompanied by a significant change in electrical conductivity (δ) of PET fibres . It was found also that for all ungrafted and grafted PET samples the (δ) increases with temperature. The more the amount of the grafted PGMA the less the increase in (δ) with temperture. The apparent activation energy decreases appreciably

with the increase of the grafted amount of PGMA.

The effect of garfting of PGMA on morphological properties of PET fibres was evaluated by differential thermal analysis (DTA) and thermogravimetric analysis (TGA). The thermograms of DTA of both native and grafted PET fibres revealed that neither the glass transition temperature nor the melting point of PET is changed due to grafting of PAMG. Thermogravimetric analysis revealed that, thermal decomposition of grafted fibres generally starts at relatively lower temperature than in case of native PET fibres. The higher the graft level the lower the temperature at which thermal degradation starts.

The mechanical properties (tenacity, breaking elongation and young's modulus) of PET fibres, grafted with GMA to different graft levels have been investigated. It was observed that grafting of PET fibres with GMA is accompained by a loss in strength and elongation. Fibres contain less amount of grafted PGMA retain more strength and elongation than that with more graft yield. No significant change in young's modulus was observed, irrespective of the graft level.

The Stability of the epoxy groups was evaluated by the comparison between the calculated amount of epoxy groups based on the increase in weight (A) and that of the experimentally determined using back titration method (B). It was found that (A) are significantly higher than (B). This signifies that the epoxy ring of the grafted PGMA is not staple. The higher the graft yield the lower the stability of the epoxy ring.

The susceptibility of unmodified PET fibres as well as the modified ones towards dyeing with disperse, and acid dyes was investigated. It was found that graftimg of PET prior to dyeing with the disperse dye enhances the colour strength. The latter the higher the higher the percent add on.

PET fibres containing different amounts of PGMA were treated with diethylamine and the susceptiblity of treated fibres towards acid dyes was investigated. It was observed that the tendency to accept the acid dye increases with increasing the nitrogen content in the PET fibres.