INTRODUCTION

Modification of the properties of natural and synthetic polymers and fibers either via functionality changes involving, esterification, acetylation, etherification, xanthateester formation, urethanation, urea formation, oxidation; cross - linking with conventional cross - linking agents like, di-isocynates, diacidchlorides, formaldehyde, etc., and/or graftcopolymerization involving either condensation coupling with a second polymer or radical grafting with vinylmonomers imparts dramatic changes in their, physical, chemical mechanical, and biochemical properties. Among these grafting is most promising. Grafting reactions provide a potential route for significantly altering the aforesaid properties of the substrate polymers and in most of the cases leads to improvement in their properties and performance, thereby yields versatile materials for end use applications. The improvement in properties of the substrate polymers that have been achieved through grafting includes: improved mechanical properties, chemical resistance, wash-wear rating and wrinkle recovery
angles, settability, wettability, resistance to microbial degradation, adhesion to a variety of substances, dye-uptake ability, electrical conductance, thermal stability, biocompatibility etc., and the materials so produced find wide industrial and biomedical applications [1-3].

Among the substrate polymers chemically modified through grafting; cellulose, cellulose derivatives, and lignocellulose have separate identity of their own. Conscious grafting onto cellulose was first reported by John and co-workers [4] in 1953 although similar and some that earlier work in U.S.S.R. [5] and England [6] certainly preceeded it. This work was variously described as copolymerization, essentially accompanied by extensive cross-linking [5] and as polymer deposit [6]. Several hundreds of papers and many patents describing various methods of grafting onto cellulose, cellulose derivatives and to some extent lignocellulose and the applications of the grafts are available and these have been reviewed [2, 7-11].

In recent years research emphasis in the area is shifting towards the complete utilization of agricultural biomass
mostly the lignocellulosic materials. These are cheap and eternally renewable agricultural materials and is used in the manufacture of papers, textile fibers and many other industrial products. However, the use of the lignocellulosic polymers/fibers in the textile field meets with serious set-back and the major drawbacks being their poor mechanical properties, chemical resistance, dye uptake ability, ease enzymatic and microbial degradation etc. It is therefore necessary to improve the aforesaid properties and environmental performance of the above fibers before they could compete with the petrochemically derived expensive fibers like nylons, polysters and thereby find intensified textile applications.

In the context of the above outlines the present author has been interested to research on grafting onto lignocellulosic fibers using chemical methods of initiation and in this thesis presents the results of graftcopolymerization of acrylamide, methacrylamide, acrylic acid and acrylonitrile onto jute and flax fibers using potassium monopersulphate "KHSO$_5$","K$_2$S$_2$O$_8$", ceric ion "Ce(IV)" as the initiators and the changes in the textile properties like, absorption of water and water vapours (water-retention), behaviour towards
mineral acids and alkalis, tensile properties, dye uptake ability and thermal stability imparted by the grafts. The research work embodied in this thesis is put forth in four chapters; Chapter - I, includes a comprehensive upto date review on grafting onto jute and flax fibers; Chapter - II comprises the results of grafting of acrylamide, methacrylamide onto jute fibers and changes in the aforesaid properties of the grafts; Chapter - III, comprises of the results of grafting of acrylamide, acrylonitrile and acrylic acid onto flax fibers and changes in the aforesaid properties of the grafts and this is followed by Chapter - IV, comprising of the thermogravimetric results of the graft copolymers and the kinetic parameters involved in the pyrolysis.

CHAPTER - I

Chapter - I describes a comprehensive upto date review on, Graft copolymerization of Vinyl monomers onto jute and flax fibers, involving metal and non-metal ion initiators, such as; tetravalent cerium "Ce(IV)", queniquevalant Vanadium "V(v)", Permanganate ion "MnO₄⁻", Persulphate ion "S₂O₈²⁻", Fenton's reagent "H₂O₂/Fe(II)", Potassium monopersulphate "KHSO₅".
In all such systems the mechanism of graft initiation and termination have been accounted and in addition changes in the textile properties of the modified fibers have been discussed.

CHAPTER - II

1. GRAFT COPOLYMERIZATION WITH A NEW CLASS OF ACIDIC PEROXOSALT : GRAFTING OF ACRYLAMIDE ONTO JUTE FIBERS USING POTASSIUM MONOPERSULPHATE : CATALYZED BY Fe (II).

Graft copolymerization of acrylamide onto jute fibers has been studied with potassium monopersulphate catalyzed by Fe(II) in aqueous sulphuric acid under nitrogen atmosphere. The grafting reaction has been influenced by reaction time, temperature, monomer concentration, initiator, catalyst, and solvent composition.

(i) Effect of monomer / polymer ratio :

Acrylamide was graft copolymerised onto jute fibers at varying acrylamide concentration from 0.1 - 1.2 M at six
different concentrations of KHSO$_5$ between $3.23 \times 10^{-3}$ - $25.8 \times 10^{-3}$M at fixed weight of jute fibers = (0.2gms), [FeSO$_4$] = $10 \times 10^{-4}$M, Temp = 25°C, Time = 4 hours. The percent grafting was found to increase steadily with increase in monomer concentration (Table - 1, Fig. - 1, Section - III, Chapter - II). The grafting efficiency also increases with increase of monomer concentration (Table - 2, Fig. - 2, Section - III, Chapter - II).

(ii) Effect of Initiator Concentration :

The graft copolymerization was studied at various concentrations of KHSO$_5$ ($3.23 \times 10^{-3}$ - $25.8 \times 10^{-3}$M) with a series of M/P ratios (5.61 - 56.1), under the conditions, jute = 0.2gms, [FeSO$_4$] = $10 \times 10^{-4}$M, Temp = 25°C, Time = 4 hours. The percent grafting increases with increase in KHSO$_5$ concentration upto $12.9 \times 10^{-3}$M, beyond which it decreases. (Table - 3, Fig. - 3, Section - III, Chapter - II)

(iii) Effect of Catalyst Concentration :

Acrylamide was graft copolymerized onto jute fibers under
the conditions; jute = 0.2gm, [AM] = 1.0M, [KHSO₅] = 12.9 x 10⁻³ and Time = 4 hours at varying concentrations of FeSO₄ [0.25 x 10⁻⁴ - 30.0 x 10⁻⁴M] and number of temperatures (20 - 50°C). Percent grafting was found to increase with increase of FeSO₄ concentration upto 20.0 x 10⁻⁴M in a low temperature range upto 25°C and upto 10.0 x 10⁻⁴M for higher temperature beyond 25°C (Table - 4, Fig. - 4, Section - III, Chapter - II).

(iv) Effect of temperature:

Acrylamide was graft copolymerized onto jute fibers under the conditions; jute = 0.2gms, [AM] = 1.0M, [KHSO₅] = 12.9 x 10⁻³M, Time = 4 hours, at three Fe(II) concentrations (10.0 x 10⁻⁴ - 30.0 x 10⁻⁴M) and number of temperatures (20 - 50°C). The percent grafting increased upto 25°C and then decreased (Table - 5, Fig. - 5, Section - III, Chapter - II).

(v) Effect of Solvent Composition:

Acrylamide was graft copolymerized onto jute fibers under
the conditions, jute = 0.2gms, [AM] = 1.2M, 
[KHSO₅] = 12.9 x 10⁻³M, [FeSO₄] = 1.0 x 10⁻³M separately in
the presence of acidic acid and methanol of various
composition (5:95 to 50 : 50). It is observed that the
percent grafting progressively decreased from the control
value with increase in solvent composition (Table - 6,
Fig. - 6, Section - III, Chapter - II).

Plausible explanations for the effect of the above reactants
and additives in the grafting of acrylamide onto jute fibers
and the mechanism of the graft initiation and termination
have been furnished in Section - IV, along with various
properties of the graft copolymers.

2. GRAFT COPOLYMERIZATION OF METHYL ACRYLAMIDE ONTO JUTE
FIBERS INITIATED BY PEROXYDISULFATE CATALYZED BY Fe(III).

Graft copolymerization of Methyl acrylamide (MAM) onto jute
fibers has been studied with potassium peroxydisulphate/
Fe(III) system as the initiator in an aqueous medium under
nitrogen atmosphere. The following aspects have been studied.
(i) Effect of monomer concentration:

Graft copolymerization of methyl acrylamide (MAM) onto jute fibers has been studied at different monomer concentrations = (0.1 - 1.0M) with fixed concentration of $K_2S_2O_8 = (0.01M)$, jute = (0.2g.), $[FeCl_3] = 1.5 \times 10^{-3} M$ at 45°C for the reaction time of 6 hours. The percent grafting increases with increase of monomer concentration up to 0.9M beyond which it decreases (Table - 7, Fig. - 7, Section - III, Chapter - II).

(ii) Effect of initiator concentration:

Graft copolymerization was studied at various initiator concentrations = $(5.0 \times 10^{-3} - 35 \times 10^{-3} M)$ with fixed concentration of methyl acrylamide = (0.8M), $FeCl_3 = (1.5 \times 10^{-3} M)$ at 45°C, for a reaction time of 6 hours. The percent grafting increased with increase in the initiator concentration up to $30 \times 10^{-3} M$ and reached a constant value (Table - 8, Fig. - 8, Section - III, Chapter - II).

(iii) Effect of catalyst concentration:

Graft copolymerization has been studied at different $FeCl_3$
concentrations $(0.25 \times 10^{-4} \text{M} \text{ - } 20 \times 10^{-4} \text{M})$ with fixed concentrations of jute = (0.2g.), $K_2S_2O_8$ = (0.01M), MAM = (0.2 M), temperature = (45°C) for a reaction time of 6 hours. It has been observed that the percent grafting increases on increasing the concentration of $\text{FeCl}_3$ upto $15 \times 10^{-4} \text{M}$ and then decreases (Table - 9, Fig. - 8, Section - III, Chapter - II).

(iv) Effect of Temperature :

Graft copolymerization of methyl acrylamide onto jute fibers has been studied at a number of temperatures (35°C - 60°C) for fixed weight of jute = (0.2g.), $[\text{MAM}] = 0.8 \text{M}$, $[\text{Fe(III)}] = 1.5 \times 10^{-3} \text{M}$, $[K_2S_2O_8] = 0.03 \text{M}$ for a reaction time of 6 hours. It has been observed that the percent grafting increases upto 50°C and then decreases. (Table - 10, Fig. - 7, Section - III, Chapter - II).

(v) Effect of Organic Solvents :

Effect of organic solvents like acetic acid, formic acid, methanol, acetone and pyridine of various composition
(2.5 : 97.5 - 15 : 85 V/V) on the percent grafting has been studied at 50°C for jute = (0.2 g.) at fixed concentrations of MAM = (0.8 M), K₂S₂O₈ = (0.03 M), Fe(III) = (1.5 × 10⁻³ M), for a reaction time of 6 hours. The results of such studies show that the presence of acetic acid and formic acid of 2.5% to 5% (V/V) in the reaction mixture enhances grafting and beyond 5% there is progressive decrease in the graft percentage. It is also noticed that with rest of solvents a progressive decrease in the percent grafting from the control value is noticed right from 2.5% (V/V) onwards. (Table - 15, Section - IV, Chapter - II).

Plausible explanations for the effects of above reactants and additives and the mechanism of graft initiation and termination have been furnished in Section - IV of Chapter - II along with various properties of the graft copolymers and the parent jute fibers except the thermogravimetric analysis which has separately been presented in Chapter - IV.
GRAFT COPOLYMERIZATION OF VINYL MONOMERS ONTO FLAX FIBERS.

1. GRAFT COPOLYMERIZATION OF ACRYLAMIDE ONTO FLAX AND
OXIDISED FLAX FIBERS INITIATED BY KHSO₅/Fe(II) SYSTEM.

Graft copolymerization of acrylamide (AM) onto flax fibers
has been studied with potassium monopersulphate/Fe(II) redox
system as the initiator in an aqueous medium under nitrogen
atmosphere. The following aspects have been studied.

(i) Effect of monomer / polymer ratio:

Effect of various monomer / polymer ratios on the grafting
of AM onto flax fibers was studied at a number of monomer/
polymer ratios between 11.22 to 67.32 at seven different
concentrations of KHSO₅ between 0.5 x 10⁻³ M to 15 x 10⁻³ M at
fixed concentration of Fe(II) = 1.5 x 10⁻³ M, flax = 0.2g.,
temperature = 35°C for a reaction time of 2 hours. The
percent grafting was found to increase steadily with increase
in the concentration of monomer (monomer / polymer ratio) (Table - 1, Fig. - 1, Section - III, Chapter - III).

(ii) Effect of Initiator (KHSO₅) concentration:

The effect of KHSO₅ concentration on grafting reaction was investigated at varying concentrations of KHSO₅ between 0.5 x 10⁻³M - 15 x 10⁻³M at flax = (0.2g.), [Fe(II)] = 1.5 x 10⁻³M, temperature = (35°C) and time = (2 hours) with a series of monomer/polymer ratios between 11.22 to 67.32. It is observed that the percentage grafting increases with increase of KHSO₅ concentration from (0.5 x 10⁻³M - 2.5 x 10⁻³M) beyond which it decreases. (Table - 2, Fig. - 2', Section - III, Chapter - III).

(iii) Effect of FeSO₄ concentration:

The graft copolymerization of AM onto flax fibers has been studied at varying concentrations of FeSO₄ between 0.5 x 10⁻³M - 2.5 x 10⁻³M at a number of temperatures between 25 - 50°C for flax = (0.2g.), [AM] = 0.5M, [KHSO₅] = 0.013M and time = (2 hours). The percent grafting was found to increase with increase of Fe(II) concentration upto
1.5 \times 10^{-3} \text{M} \text{ beyond which it decreases (Table - 3, Fig. - 3, Section - III, Chapter - III).}

(iv) Effect of Temperature:

Graft copolymerization of AM onto flax fibers has been studied at a number of temperatures between 25 - 50°C at fixed concentrations of \([\text{KHSO}_5] = 0.013 \text{M} , \ [\text{Fe(II)}] = 1.5 \times 10^{-3} \text{M} \ [\text{AM}] = 0.5 \text{M}, \ [\text{flax}] = 0.2 \text{g.}, \ [\text{time}] = 2 \text{ hours}. \) From the results it is noticed that graft percent increased up to 35°C and beyond which it decreased (Table - 4, Fig. - 3, Section - III, Chapter - III).

(v) Effect of solvent composition:

The effect of water soluble organic solvents such as acetic acid, formic acid, and morpholine of various compositions (5:95 - 50:50 (V/V)) on the grafting reaction has been studied at 35°C for two hours at fixed concentration of \([\text{KHSO}_5] = (2.5 \times 10^{-3} \text{M}) , \ [\text{Fe(II)}] = (1.5 \times 10^{-3} \text{M}) , \ [\text{AM}] = (1.2 \text{M}) , \ [\text{flax}] = (0.2 \text{g.}). \) The results presented in Table - 13, Section - IV, Chapter - III, show that, percent grafting increases
with acetic acid from composition (5:95 - 20:80 (V/V) beyond which it decreases. With formic acid of cited composition retardation of grafting is always noticed. In the presence of morpholine the grafting reaction is completely inhibited.

(vi) Effect of the nature of the substrate polymers:

Flax oxidised with 0.5% periodic acid for various time intervals influences grafting to a higher extent. The results of percent grafting for flax oxidised with 0.5% periodic acid for various hours and grafted under the condition: 

\[ [\text{KHSO}_5] = 2.5 \times 10^{-3} \text{M}, [\text{Fe(II)}] = 1.5 \times 10^{-3} \text{M}, [\text{AM}] = 1.2 \text{M}, \]

flax = 0.2g. Temperature = 35°C, Time = 2 hours are presented in Table - 14, Section - IV of Chapter - III. It is observed that a maximum of 174.1% of grafting is obtained with flax oxidised with 0.5% periodic acid for two hours. However, even though the percentage of grafting for all the samples except those oxidised for 20, 22 and 24 hours are higher than the control value but beyond 2 hours of oxidation time the percentage grafting decreases with increase in the time of oxidation of the flax fibers.

Plausible explanations for the effect of above reactants
and additives in the grafting of acrylamide onto flax and oxyflax fibers and the mechanism of graft initiation and termination have been furnished in Section - IV of Chapter - III along with various properties of graft copolymers and the parent flax fibers except the thermogravimetric analysis which has been separately presented in Chapter - IV.

2. GRAFT COPOLYMERIZATION OF ACRYLONITRILE ONTO FLAX AND OXIDISED FLAX FIBERS INITIATED BY KHSO₅/Fe(II) REDOX SYSTEM.

Graft copolymerization of acrylonitrile (AN) onto flax fibers has been studied with potassium monopersulphate/Fe(II) redox system as the initiator in an aqueous medium under nitrogen atmosphere. The following aspects have been studied.

(i) Effect of FeSO₄ concentration:

The graft copolymerization of AN onto flax fibers has been studied at varying concentrations of FeSO₄ between 0.5 x 10⁻⁴ M to 5.0 x 10⁻⁴ M at a number of temperatures between 50°C to 65°C for fixed concentration of AN = (0.754 M),
KHSO$_5$ = (5 x 10$^{-3}$M), flax = (0.2g.) for a reaction time of 4 hours. The percent grafting was found to increase with increase of Fe(II) concentration upto 2.0 x 10$^{-4}$M beyond which decreases (Table - 5, Fig. - 4, Section - III, Chapter - III).

(ii) Effect of Temperature:

Graft copolymerization of acrylonitrile onto flax fibers has been studied at different temperatures (50°C - 65°C) for fixed weight of flax = (0.2g.), [AN] = 0.754M, [KHSO$_5$] = 5 x 10$^{-3}$M for a reaction time of 4 hours. It has been observed that percent grafting increases upto 60°C and then decreases. (Table - 6, Fig. - 5, Section - III, Chapter - III).

(iii) Effect of monomer/polymer ratio:

Effect of monomer/polymer ratios (monomer concentration) on the grafting of AN onto flax fibers was studied at a number of monomer/polymer ratios between 2.001 to 12.006 with six different concentrations of KHSO$_5$ between 1.0 x 10$^{-3}$M to 7.5 x 10$^{-3}$M at fixed concentration of
Fe(II) = 2 \times 10^{-4} \text{M}, \text{flax} = 0.2 \text{g}, \text{temperature} = 60^\circ \text{C for a reaction time of 4 hours}. \text{The percent grafting was found to increase steadily with increase in the concentration of monomer (monomer/polymer ratio) Table - 7, Fig. - 6, Section - III, Chapter - III).}

(iv) Effect of Initiator (KHSO}_3\text{) concentration:}

The effect of KHSO}_3\text{ concentration on grafting reaction was investigated at varying concentrations of KHSO}_3\text{ between 1.0 \times 10^{-3} \text{M to 7.5 \times 10^{-3} M with a series of monomer/polymer ratios between 2.001 to 12.006 for flax = \left(0.2\text{gm}, [Fe(II)] = 2 \times 10^{-4} \text{M at 60}^\circ \text{C for 4 hours (Table - 8, Fig.-7, Section - III, Chapter - III). It is observed that the percentage grafting increase with increase of KHSO}_3\text{ concentration from 1.0 \times 10^{-3} \text{M to 2.5 \times 10^{-3} M beyond which it decreases.}}}

(v) Effect of solvent composition:

The effect of organic solvents on the course of grafting has been studied at various solvent compositions of
(5:95 - 50:50 V/V) at 60°C for fixed concentration of AN = (1.131M), flax = (0.2g.), KHSO₅ = (2.5 x 10⁻³M), Fe(II) = (2 x 10⁻⁴M) for a reaction time of 4 hours. The results of such studies with solvents like acetic acid, methanol, Dimethyl sulfoxide (DMSO) and morpholine are given in Table - 19, Section - IV of Chapter - IV. It is seen that with methanol, DMSO and acetic acid there is a progressive decrease in percent grafting whereas with morpholine grafting is completely inhibited.

(vi) Effect of the nature of the substrate polymers:

Flax oxidised with 0.5% periodic acid for various time intervals influences grafting to a higher extent. The results of percent grafting for flax oxidised with 0.5% periodic acid for various hours and grafted under the condition: time = 4, temp. = 60°C for fixed concentration of KHSO₅ = (2.5 x 10⁻³M), Fe(II) = (2.0 x 10⁻⁴M), AN = (1.131M), flax = (0.2g.) are presented in Table - 20, Section - IV, of Chapter - III. It is observed that a maximum of 142.8% grafting is obtained with flax oxidised with 0.5% periodic acid for 10 hours. The percentage of grafting increases
with increase in the time of oxidation of the flax fibers.

Plausible explanations for the effects of above reactants and additives in grafting of acrylonitrile onto flax and oxy flax fibers and the mechanism of graft initiation and termination have been furnished in Section - IV of Chapter - III along with various properties of the graft copolymers and the parent flax fibers except the thermogravimetric analysis which has been separately presented in Chapter - IV.

3. GRAFT COPOLYMERIZATION OF ACRYLIC ACID ONTO FLAX AND OXY FLAX FIBERS INITIATED BY Ce(IV) ION.

Graft copolymerization of acrylic acid (AA) onto flax fibers has been studied with ceric ion (Ce+IV) as an initiator in an aqueous nitric acid medium under nitrogen atmosphere. The following aspects have been studied.

(i) Effect of acid concentration :

Acrylic acid was graft copolymerized with defatted flax fibers initiated by Ce(IV) at varying nitric acid
concentrations (0.15 - 0.4M) for fixed concentration of AA = (1.453M), Ce(IV) = (0.01M), Flax = (0.2g.) at 50°C for a reaction time of 4 hours. The results of such studies are presented in Table - 23, Section - IV of Chapter - III. It is observed that the increase of HNO₃ concentration in the reaction mixture enhances the percent grafting.

(ii) Effect of monomer/polymer ratio:

The effect of monomer/polymer ratio (monomer concentration) on the grafting of acrylic acid onto flax was studied at a series of monomer concentration between 0.1815M - 1.815M with fixed concentrations of Ce(IV) = 7.5 x 10⁻³M, H⁺ = (0.3M), flax fiber = (0.2g.) for 4 hours and at five different temperatures from 30°C - 50°C. The percent grafting was found to increase steadily with increase in monomer concentration (monomer/polymer ratio) as well as the temperature simultaneously Table - 9, Fig. - 8, Section - III Chapter - III.

(iii) Effect of initiator [Ce(IV)] concentration:

Graft copolymerization of acrylic acid onto flax fibers has
been studied at various initiator concentrations (1 x 10^{-3}M to 20.0 x 10^{-3}M) for fixed concentration of AA = 1.453M, H^+ = 0.3M, flax = 0.2g., at number of temperatures = 30°C - 50°C for 4 hours. It has been observed that the percent grafting increases with increase in initiator concentration upto 7.5 x 10^{-3}M and then decrease. (Table - 10, Fig. - 9, Section - III, Chapter - III).

(iv) Effect of Temperature:

Graft copolymerization of acrylic acid onto flax fibers has been studied at temperatures ranging from 30°C to 50°C for fixed concentration of [AA] = 1.453M, [H^+] = 0.3M, [Ce(IV)] = 7.5 x 10^{-3}M, flax = 0.2g., for 4 hours. The percent grafting increases with increase in reaction temperature. (Table - 11, Fig. - 8, Section - III, Chapter - III).

(v) Effect of solvent composition:

Graft copolymerization of acrylic acid onto flax fibers has been studied in the presence of various organic solvents
such as acetic acid, formic acid, acetone, methanol and pyridine of composition varying from 5:95 to 50:50 (V/V) at 45°C for 4 hours and at fixed concentration of AA = (1.453M), Ce(IV) = (7.5 x 10⁻³M), H⁺ = (0.3M), flax = (0.2g.). It is observed that there is a progressive decrease in the graft percentage with increase in solvent compositions for solvents like acetic acid, formic acid, and acetone. Further with pyridine and methanol a strong retardation in percent grafting is observed even at low composition 5%(V/V) followed by complete inhibition. (Table - 24, Section - IV, Chapter - III).

(vi) Effect of the nature of the substrate polymers:

Flax oxidised with 0.5% periodic acid for various time intervals influences grafting to a higher extent. The results of percent grafting for flax oxidised with 0.5% periodic acid for various hours and grafted under the condition: flax = 0.2gm., [Ce(IV)] = 7.5 x 10⁻³M, [H⁺] = 0.3M, [AA] = 1.453M, Temperature = 45°C, Time = 4 hours, presented in Table - 25, Section - IV, Chapter - III.

It is observed that the percent grafting progressively
increases with the time of oxidation of the flax fibers with periodic acid.

Plausible explanations for the effects of above reactants and additives in the grafting of acrylic acid onto flax and oxy flax fibers and the mechanism of graft initiation and termination have been furnished in section - IV of Chapter - III along with various properties of the graft copolymers and the parent flax fibers.

CHAPTER - IV

THERMOGRAVIMETRIC ANALYSIS OF JUTE AND FLAX FIBERS AND THEIR RESPECTIVE GRAFT COPOLYMERS.

The thermogravimetric analysis (TGA) of parent jute and flax fibers and jute-g-PMAM, flax-g-PAM, and flax-g-PAN samples have been carried out. The kinetic parameters such as the order of reaction "n" for the parent jute and jute-g-PMAM samples of 44.4, 60.4 and 70.6 percent grafting has been calculated to be 1.5, 1.0, 1.2 and 1.0 respectively. Further the activation energy 'E' for the pyrolysis systems involving the parent jute and jute-g-PMAM samples of 44.4,
60.4 and 70.6 percent grafting has been calculated to be 17.6 K. Cal./Mole, 24.5 K. Cal./Mole, 36.6 K. Cal./Mole and 27.8 K. Cal./Mole respectively.

The order of reaction 'n' for the parent flax and flax-g-PAM samples of 10.1, 20.2, 33.25 and 46.9 percent grafting has been calculated to be 1.0, 1.16, 0.98, 1.1 and 0.94 respectively. Further the activation energy 'E' involved in the pyrolysis of the parent flax and flax-g-PAM samples of 10.1, 20.2, 33.25, and 46.9 percent grafting has been calculated to be 10.02 K. Cal./Mole, 10.26 K. Cal./Mole, 10.71 K. Cal./Mole, 14.34 K. Cal./Mole and 18.54 K. Cal./Mole respectively.

Further the order of reaction 'n' for the parent flax and flax-g-PAN samples of 56.6, 95.65, and 118.7 percent grafting have been calculated to be 1.0, 1.0, 1.25 and 0.89 respectively. In addition the activation energy 'E' involved in the pyrolysis of the parent flax and flax-g-PAN samples of 56.6, 95.65 and 118.7 percent grafting, has been calculated to be 10.02 K. Cal./Mole, 15.93 K. Cal./Mole, 16.11 K. Cal./Mole, and 16.29 K. Cal./Mole respectively.
The details of the theoretical aspects and evaluation of kinetic parameters on the basis of Freeman and Carroll equations involved in the pyrolysis of the aforesaid samples have been described in this chapter.


