

RADO, Janos, dr.; FRANK, Magda, dr.; FENYES, Imre, dr.; Technikai
Munkatars: Fulop, Belane, assisztens

Kidney function in diabetic coma. Orv. hetil. 98 no.24:
650-653 16 June 57.

1. A Janos Korhaz Rendelointezet (igazgato-foorvos:
Bakacs, Tibor, dr.) II. sz. Belosztalyanak (foorvos:
Benceath, Aladar, dr.) Prosecturajanak (foorvos:
Kallo, Antal, dr., az orvostudomanyok doktora) es
Kozponti Laboratoriumanak (foorvos: Hammer, Sarolta, dr.)
kozlemenye.

(DIABETES MELLITUS, compl.

coma, kidney funct., prognostic significance (Hun))

(KIDNEYS, in various dis.

diabetic coma, prognostic significance of funct. (Hun))

RADO, Janos, Dr.; ABRAHAM, Karola, Dr.; ESZEKI, Jozsef, Dr.

Simultaneous occurrence of congenital septal defect and cardiac infarct in old age. Orv. hetil. 98 no.39:1079-1081 29 Sept 57.

1. A Janos Korhaz-Rendelointezet (igazgato: Bakacs Tibor dr.) II. sz. Belosztalyanak (foorvos: Bencsath Aladar dr.) es Prosecturajanak (foorvos: Kallo Antal dr., az orvostudomanyok doktora) kozlemenye.

(CARDIAC SEPTUM, abnorm.

interventric. septal defect with myocardial infarct in aged, case report (Hun))

(MYOCARDIAL INFARCT, case reports

with interventric. septal defect in aged (Hun))

EXCERPTA MEDICA Sec 18 Vol 3/4 Cardiovascular Dis. Apr 59

1063. The clinical and pathological aspects of interventricular septal perforation in the light of the literature and personal cases Die klinischen und pathologischen Probleme der interventrikulären Septumperforation im Lichte der Literatur und unserer eigenen Fälle. RADÓ J., KISSESSY A. and FOMOR I. 2. Inn. Abt., János-Krankenl., Budapest *Z. ges. inn. Med.* 1958, 137 (227-235) Graphs 2 Tables 1 Illus. 3

In one of the two cases of perforation of the interventricular septum diagnosed in vivo and confirmed at autopsy, double heart rupture was present: rupture of the right ventricular wall had joined the perforation of the interventricular septum. In the other case the course of the disease was unusual: the only sign of septum perforation was the sudden appearance of a characteristic systolic murmur, whereas stenocardia and dilatation were absent. A survey is presented of the literature on the perforation of the septum. The authors, on the basis of 2 cases in which the congenital septum defect was associated with cardiac infarction, add the former to the list of conditions that play a role in differential diagnosis. According to the statistical analysis septum perforation, but particularly rupture of the heart, is more frequent in aged individuals with cardiac infarction. Perforation of the septum is more common in females with cardiac infarction and the majority of the patients also suffer from hypertension. In the genesis of the perforation of the interventricular septum the authors attribute great significance to a difference in interventricular pressures. Although infarction spreads most frequently also to the septum, perforation of the latter is a most uncommon occurrence. Rupture of the heart is much more common and often takes place transeptally or paraseptally. (XVIII, 6, 9)

EXCERPTA MEDICA Sec 18 Vol 3/2 Cardio. Dis. Feb 59

365. *The role of venous constriction in circulatory disorders* RABÓ J. P., GOSDA E. and KOVÁCS E. Dept. of Med. II, János Hosp., Budapest *Brit. Heart J.* 1958, 20:3 (389-396) Graphs 5 Tables 3

The effect of sodium nitrite on venous pressure was examined in congestive heart failure, in hypertensive disease without heart failure, and in control subjects with a normal circulation. The investigations were repeated in the course of the treatment of heart failure and also when reaching the optimal compensation. It was found that (1) in every phase of heart failure, (2) in patients reaching the optimal compensation, and (3) in hypertensive disease without heart failure, the venous pressure fell under the influence of sodium nitrite more than in control subjects. In the 3 following groups: (1) control subjects, (2) hypertensive patients without heart failure or those with previous heart failure that has become compensated by treatment, and (3) patients with heart failure, the fall of venous pressure of the cases with equal venous pressure was lowest in the 1st group, highest in the 3rd group, and intermediate in the 2nd group. The fall of venous pressure induced by sodium nitrite did not correlate with the decrease of arterial pressure. The fall of venous pressure induced by sodium

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nitrite results from a suppression of venoconstriction, by decreasing the increased venomotor tone. These investigations suggest that the increase of venomotor tone in cardiac decompensation is an early and common phenomenon. The effect of sodium nitrite can be used also as a test to decide whether the increased venoconstriction plays a role in the venous pressure beyond or within the normal range. With its help the improvement of heart failure can be followed. (XVIII, 6*)

RADO, Janos, dr.; BLUMENFELD, Gyula, dr.; HAMMER, Sarolta, dr.

Prednisone therapy of novurite-induced refractory cardiac edem. III. Significance of tubular mechanisms in the reversal of mercurial sensitivity. Magy.belorv.arch. 12 no.6:183-188 D '59.

1. A Janos Korhaz-Rendelointezet (igazgato foorvos: Tako Jozsef dr.)
Izotop V. Belosztalyanak (foorvos: Tako Jozsef dr.), II. sz.
Belosztalyanak (foorvos: Goth Kndre dr.) es Kozponti Laboratoriumanak
(foorvos: Hammer Sarolta dr.) kozlemenye.
(PREDNISONE pharmacol)
(HEART FAILURE CONGESTIVE exper)

RADO, Janos, dr.; HANVAS, Jozsef, BIKICH, Georgy, dr.

Role of various factors in the pathogenesis of skin hemorrhage
(steroid ecchymosis) due to new glucocorticoids. Magy belorv. arch.
14 no.3:107-118 J1 '61.

1. A Janos Korhaz-Rendelointezet (Igazgato-foorvos: Tako Jozsef dr.)
(Izotop osztalyanak (Foorvos: Tako Jozsef dr.) es Anyagcsereszakrende-
lesenek (Foorvos: Bikich Gyorgy dr.) kozlemenye.

(ADRENAL CORTEX HORMONES toxicol)
(SKIN dis) (HEMORRHAGE etiol)

RADO, Janos, dr.; HAMMER, Sarolta, dr.; SZILAGYI, Laszlo, dr.; technikai
assistens: HIDEG, Katalin

Effect of new synthetic glucocorticoids (dexamethasone and medrol)
on mercurial diuresis in liver cirrhosis. IV. Experimental studies
on the renal and extrarenal effect of steroids with special reference
to the concentrating capacity of the kidney. Magy. Belorv. arch. 15
no.1:16-29 Fe '62.

1. A Janos Korhaz Rendelointezet Izotop (V.bel) osztalyanak,
Anyagesereszakrendelesenek es Kozponti Laboratoriumanak kozlemenye.
(DEXAMETHASONE ther) (PREDNISOLONE rel cpds)
(LIVER CIRRHOSIS ther) (DIURETICSM MERCURIAL ther)

RADO, Janos, dr.; HAMMER, Sarolta, dr.; SZILAGYI, Laszlo, dr.; technical
asszisztens: CZIBULA, Etelka; HIDEG, Katalin

Effective treatment of decompensated liver cirrhosis with new
synthetic glucocorticoids (6 methylprednisolone, Oradexon^R) and
thiazide compounds (dihydrochlorothiazide, chlorthalidone-Hygrotone^R,
bendroflumethiazide) combined with mercurial diuretics. Magy. belorv.
ardh. 15 no.4:144-156 Ag '62.

1. A Janos Korhaz Rendelointezet Izotop Osztalyanak es Kozponti
Laboratoriumanak kozlemenye.

(LIVER CIRRHOSIS)	(CUSHING'S SYNDROME)	(METHYLPREDNISOLONE)
(DEXAMETHAZONE)	(HYDROCHLORTHIAZIDE)	(CHLORTHIAZIDE)
(DIURETICS, MERCURIAL)	(HEPATITIS)	(ALKOHOLISM)
(CHOLELITHIASIS)	(COLLAGEN DISEASES)	

RADO, Janos, dr.; TAKO, Jozsef, dr.; GEDER, Laszlo, dr.; JENEY, Eniko, dr.;
Munkatars: GOSCHL, Irma.

Group occurrence of herpes zoster in patients treated with
corticosteroids. Orv. hetil. 105 no.27:1266-1270 5 J1'64

1. Budapesti Janos Korhaz, Izotop (V.Bel.) Osztaly es Debreceni
Orvostudomanyi Egyetem, Mikrobiologiai Intezet.

TAKO, Jozsef, dr.; RADO, Janos, dr.

Generalized herpes zoster complicated by meningitis in a
patient treated with corticosteroids. Orv. hetil. 105
no.27:1271-1273 5 J1'64

1. Budapesti Janos Korhaz, Izotop (V. Bel.) Osztaly.

RADU, Janos, dr.; TAKI, Jozsef, dr.; NIKLAS, Gyorgy, dr.

Chromophobe pituitary adenoma associated with Cushing's
syndrome. Orv. hetil. 106 no. 5:221-226 31 Ja 1965

I. Fovarosi Janos (Orham, Isotop (W.5el.) Szitaly es
Prosectura.

TAKO, Jozsef, ir.; RADO, Janos, dr., munkatars; SZANTO, Ervinne, dr.

Changes in the "functional reserve capacity" of the pituitary gland and the adrenal cortex under the effect of antithyroid therapy. Orv. hetil. 106 no.35:1646-1650 29 Ag '65.

1. Fovarosi Janos Korhaz, Izotop (V. Bel.) Gsztyaly.

RADO, KAROLY

KOMAROMY, Jozsef, dr; TAKACS-NAGY, Lorand, dr; RADO, Karoly, dr

Case of renal osteodystrophy. *Magy belorv. arch.* 7 no.3:94-96
June 54.

1. Budapesti Orvostudományi Egyetem III. sz. Belklinikájának
(igazgató: dr Gomori Pal egyetemi tanár) és a III. sz. Sebészeti
Klinika (igazgató: dr Rubanyi Pal egyetemi tanár) Prosecturájának
közleménye.

(RICKETS, RENAL)

RADO, Karoly, dr.; RADNAI, Bela, dr.; TAKACS-NAGY, Lorand, dr.

Case of metastasis of sarcoma to kidneys with unusual symptoms.
Magy. sebeszet 7 no.1:73-76 Feb 54.

1. A Budapesti Orvostudományi Egyetem III. sz. Sebészeti Klinikájának közleménye. Igazgató: Rubanyi Pal dr. egyet. tanár.

(SARCOMA

leg, metastasis to kidneys, surg.)

(KIDNEYS, neoplasms

sarcoma, metastatic from leg, surg.)

(LEG, neoplasms

sarcoma, metastasis to kidneys, surg.)

RADO, R.

8

M. A. YOOTZ
2 copies

chem

The kinetic relations of the polymerization without pressure of trifluorochloroethylene in pentachloroethane. M. LAZAR and R. RADO (Vyskumný ústav Kábelov, Bratislava; Czech. Chem. Zvesti 10, 1: 1-10 (1935) (German summary).—The kinetic relations are described for the polymerization (initiated by Bz_2O_2) in a soln. of C_2F_3Cl in C_2HCl_3 . The method is based on the measurements of decrease of concn. of C_2F_3Cl during the polymerization. The exponent of the dependence of the polymerization speed on the concn. of the initiator is 0.3 at 70–80° which agrees with the findings of Thomas and O'Shaughnessy (C.A. 48, 3771a). The total active energy of the polymerization is 26 kcal./mol., and the active energy of the initiation process is 30.5 ± 1.5 kcal./mol. The initiation process is caused by the radicals from the soln., formed during the polymerization, and the growth of the polymer chain is as usual. The ending of the growth of the chain causes 2 reactions simultaneously, occurring by the termination of retardation and by the termination of recombination.

Jan Micka

PM

Rado, R.

7

The decomposition of benzoyl peroxide in pentachloroethane in the presence of trifluorochloroethylene. R. Rado and M. Lazár (Výskumný Ústav Kábelov, Bratislava, Czech.). *Chem. Zvesti* 10, 282-7 (1956) (German summary).

The velocity consts. of spontaneous and induced decompn. of Bz_2O_2 in pentachloroethane (I) at $03.7^\circ \pm 0.1^\circ$ and in the presence of trifluorochloroethylene (II) at 78.3° , 80.8° , and $95.7^\circ \pm 0.1$ were detd. The velocity of the total decompn. can be expressed in the equation $-d[i]/dt = k_1[i] + k_2[i]^n$, where $[i]$ is the concn. of Bz_2O_2 , k_1 is the velocity const. of unimol. spontaneous decompn., and k_2 is the velocity const. of induced chain decompn. Exponent $n = 2$ is the most suitable. The presence of II increases the decompn. of Bz_2O_2 in the soln. of I. In the polymerization without pressure of II in the soln. of I, initiated by Bz_2O_2 , the effectiveness of the initiator is 0.56 ± 0.03 . Jan Micka

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RADO, R.

in Phys

The polymerization of trifluorochloroethylene by γ -radiation. M. Lazár, R. Rado, and N. Klíman (Výskumný ústav kabelov a izolací, Bratislava, Czech.). *Chem. zvesti* 10: 585-8 (1956) (German summary).—The block polymerization of trifluorochloroethylene initiated by Co^{60} at various radiation temps. and intensities is described. In the limits of the ionization intensity 30-1000 r./hr., the polymerization rate is directly related to square root of the intensity of radiation. The inner viscosity of the polymers and the dependence of the polymerization rate and mol. wt. on temp. are discussed.
Jan Micka

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RADO, R.

The kinetics of the polymerization of trichloroethylene in pentachloroethane / M. Lazár and R. Rado (Věskumný ústav káblův izolací, Bratislava, Czech.). Chem. zvesti 11, 383-9 (1957) (German summary).—By detg. the polymerization velocity at changing concns. of trichloroethylene in pentachloroethane (I) (0.3-2.5 mol./kg.) at 70.3, 80.1, and 90.3° and by comparing the velocity const. of the initiation and the unimol. decompn. of Bz_2O_2 , it was found that the velocity of the polymerization increases directly in the relation with the concn. of the monomer. The velocity of the initiation is detd. exclusively by the spontaneous decompn. of the initiator. At a monomer concn. of 1.5 mol./kg. and at 80.3° there is a square-root relation of the polymerization velocity to the concn. of Bz_2O_2 . It was assumed that at the initiation reaction there is a participation of I.

5

1/1

PM

RADO, R.

1959, Mechanism of the initiation of polymerization reactions by gamma radiation. *J. Polym. Sci. A-1*, 17, 2727. Nineteen references are given and there is a German summary.

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Pol, Mol 4

CZECHOSLOVAKIA/Chemistry of High Molecular Substances.

I

Abs Jour: Referat. Zhurnal Khimiya, No 10, 1958, 34981.

Author : Rudolf Račo, Milan Lazar.

Inst : Not given.

Title : Thermal Degradation of Polytrichlorofluoroethylene.

Orig Pub: Chem. průmysl., 1957, 7, No 8, 457-459.

Abstract: The thermal dissociation of polytrifluorochloroethylene at 340° under atmospheric pressure was studied by the method of weight losses and change of characteristic viscosity dependent of the destruction duration. A mechanism of chain degradation based on the assumption of random initiation by C-C bond scission is suggested. The chain development consists in splitting off of monomer molecules. The

Card : 1/2

RADE, RUDOLF

H-29

CZECHOSLOVAKIA/Chemical Technology - Chemical Products and Application. Synthetic Polymers. Plastics.

Abs Jour : Ref Zhur - Khimiya, No 8, 1958, 26999

Author : Lazar Milan, Rado Rudolf

Inst : -

Title : Fluorinated Hydrocarbons and Their Derivatives as Thermostable Insulating Materials.

Orig Pub : Strojnoelektrotechn. casop., 1957, 8, No 1, 54-66

Abstract : A review article concerning current concepts of the causes which bring about chemical inertness and thermal stability of polymeric fluorohydrocarbons and their derivatives. It is noted that the most promising course of development of new thermostable insulating fluoro-polymers is one of the following: copolymerization of tetrafluorethylene and hexafluoropropylene, synthesis of silicones in which organic radicals are substituted by

Card 1/2

CZECHOSLOVAKIA/Chemistry of High Molecular Substances. I

Abs Jour: Referat. Zhurnal Khimiya, No 10, 1958, 34964.

Author : M. Lazar, R. Rado.

Inst : Not given.

Title : The Question of Trifluorochloroethylene Polymerization
in Pentachloroethane.

Orig Pub: Chem. zvesti, 1957, 11, No 7, 383-389.

Abstract: The polymerization kinetics of trifluorochloroethylene in pentachloroethane solution at 70 to 90° was studied; benzoyl peroxide was the initiator. It is shown that the reaction rate rises linearly together with the monomer concentration. The initiation rate (found by the inhibition method) is determined by the monomolecular decomposition of the initiator. It is assumed that the solvent participates in the initiation reaction.

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Monthly radiation and polymer. p. 378

Министерство (Ministerstvo energetiki)
Prava, Sveskoleniiskia Vol. 5, no. 1, Dec. 1959

Monthly List of East European Accession, (1951), 14, Vol. , No. 12, Dec. 1959
Uncl.

RADO, R.

PHASE I BOOK EXPLOITATION SOV/4984

International symposium on macromolecular chemistry. Moscow, 1960.

Mezhdunarodnyy simpozium po makromolekulyarnoy khimii SSSR, Moskva, 14-18 iyulya 1960 g.; doklady i avtorferaty. Sektsiya III International Symposium on Macromolecular Chemistry Held in Moscow, June 14-18, 1960; Papers and Summaries, Section III. (Moscow, Izd-vo AN SSSR, 1960) 469 p. 55,000 copies printed.

Tech. Ed.: P. S. Kashina.

Sponsoring Agency: The International Union of Pure and Applied Chemistry. Commission on Macromolecular Chemistry.

PURPOSE: This book is intended for chemists interested in polymerization reactions and the synthesis of high molecular compounds.

COVERAGE: This is Section III of a multivolume work containing papers on macromolecular chemistry. The articles in general deal with the kinetics of polymerization reactions, the synthesis of special-purpose polymers, e.g., ion exchange resins, semiconductor materials, etc. Methods of catalyzing polymerization reactions, properties and chemical interactions of high molecular materials, and the effects of various factors on polymerization and the degradation of high molecular compounds. No personalities are mentioned. References given follow the articles.

Damanov, Kh. U., U. N. Mashev, and R. S. Millard (USSR). The Radiation Method of Copolymerizing Acrylonitrile with Polystyrene and Perchlorovinyl	170
Rafikov, S. R., G. N. Chelnokova, I. V. Zhuravleva, and P. M. Orlenkova (USSR). Grafting of Carbochain and Heterochain Polyamides	184
Santo, J., and K. Gal (Hungary). Grafting Methyl Methacrylate Onto Films of Polyvinyl Alcohol Under the Action of X-Rays	207
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Kolomnikov, G. S., and Ts'eng Han-ming (USSR). Synthesis of Free Radicals on Crosslinking in Polyethylene	230
Mladenov, I., I. A. Tutorskiy, and B. A. Dostalin (USSR). On the Transformations of Carboxyl-Containing Butadiene-Styrene Rubbers and Their Mixtures With ε-Caprolactam Under the Action of Gamma Radiation	293
Rogovin, Z. A., V. A. Deravitskaya, Sun T'ung, Chang Wei-kang, and L. S. Gal'brayn (USSR). Synthesis of New Cellulose Derivatives and Other Polysaccharides	302
Yermolenko, I. N., and P. M. Kupitskiy (USSR). Initiation of the Controlled Synthesis of Modified Celluloses with Oxides of Nitrogen	310
Ivanov, V. I., N. Ya. Lenshina, V. S. Ivanova (USSR). Oxidation Transformations in Chains of Cellulose Molecules	321
Berlin, A. A., Ye. A. Penakaya, and G. I. Volkova (USSR). Mechanicochemical Transformations and Block Copolymerization During the Freezing of Starch Solutions	334
Damanov, Kh. U., B. I. Akhmedov, and U. A. Azizov (USSR). Modification of the Properties of Cellulose by Grafting	344

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RADO, R.

Z/009/60/000/009/004/005
E112/E453

17-4312

AUTHOR: Rudolf Rado
TITLE: Polyethylenes, ¹ Cross-Linked by Means of Peroxides and their Physical Characteristics

PERIODICAL: Chemický průmysl, 1960, No.9, pp.496-499

TEXT: Attempts to improve the thermal characteristics of polyethylene are outlined. Cross-linking by free-radical mechanism initiated by peroxide breakdown is considered to be the most suitable and economical method. Cross-linking by means of irradiation is considered too expensive. The suitability of different peroxides as cross-linking agents will be governed by the rate of their breakdown at temperatures of compounding. The conventional source of free radicals, namely benzoyl peroxide, has been found unsuitable by the author owing to its high rate of decomposition at the temperatures of the reaction. A study of t-butyl-perbenzoate as cross-linking agent for polyethylene is now submitted and it is held by the authors that this compound has better stability characteristics within the range of cross-linking temperatures. The present paper sets out to investigate:
1. Effect of peroxide concentration on degree and content of

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E112/E453

Polyethylenes, Cross-Linked by Means of Peroxides and their Physical Characteristics

cross-linking. II. Thermomechanical characteristics.
III. Dielectric constants. Comparisons with the linear and an irradiation cross-linked polyethylene are submitted. Two different types of polyethylene are used as starting material: high-pressure polyethylene (M.W. 23000, Alkathene 20)^W and low-pressure polyethylene (M.W. 80000, Hostalen GD 2)^W. Experimental details of the cross-linking technique are outlined. The high-pressure polyethylene is compounded for 10 min on a two-roll mill with t-butylperbenzoate at 125°C. The low-pressure polyethylene, on the other hand, is impregnated in the cold with a chloroform solution of the peroxide and excess solvent is then removed by vacuum distillation. Castings are prepared from each mixture at 160°C and a pressure of 200 kg/cm². Cross-linking is completed by extending treating time under pressure to 10 min. Rate of cross-linking was determined by a) measuring the solubility of the material in boiling carbon tetrachloride and b) by evaluating elastic deformation curves at 150°C under load (2800 g/cm). For both types of polyethylene (high and low-pressure) the effect
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Polyethylenes, Cross-Linked by Means of Peroxides and their
Physical Characteristics

of peroxide concentration upon the efficiency of cross-linking was determined. It is shown that the efficiency of cross-linking decreases as peroxide concentration is increased, 2 to 3% peroxide being the optimal concentration. Effects of peroxide concentration are summarized in a graph. Both methods of cross-linking measurements (solubility and elastic deformation) provided analogous results. The loss of cross-linking efficiency with increased peroxide concentration is explained by peroxide breakdown. The high-pressure polyethylene gave somewhat lower yields of cross-linked material than the low-pressure material. It is suggested that this may be caused by the presence of branched-off chains and tertiary carbons in the high-pressure material, facilitating chain rupture of the -C-C bonds of the principal chain. The concentration of polymer free radicals, capable of producing cross-linkages through recombination is, therefore, decreased. The effects of temperature on the elastic deformation characteristics of polyethylenes with varying proportions of cross-linkages are
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Polyethylenes, Cross-Linked by Means of Peroxides and their
Physical Characteristics

plotted in a graph which, in addition, shows also the behaviour of linear high- and low-pressure polyethylene, polypropylene and vulcanized silicone rubber respectively. It is shown that cross-linked polyethylene retains its elastic properties above its first-order transition temperature, similar to vulcanized rubber. Resistance to elastic deformation decreases in the following order: polypropylene > cross-linked low-pressure polyethylene > cross-linked high-pressure polyethylene. Cross-linked polyethylene with a cross-linking rate > 1 retains its resistance to elastic deformation under load even at temperatures above the melting point of polypropylene. Tested under identical conditions, however, the low-pressure polymer showed better thermomechanical characteristics than the high-pressure material. Cross-linking also causes a slight improvement of tensile strength and reduction of elongation. Dielectric constants, on the other hand, are deteriorated not only in comparison with the linear polymer but also a cross-linked polyethylene produced by means of irradiation. The deterioration of these characteristics is explained by the presence in the peroxide cross-linked material

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Z/009/60/000/009/004/005
E112/E453

Polyethylenes, Cross-Linked by Means of Peroxides and their
Physical Characteristics

of peroxide breakdown by-products. Electrical properties are
tabulated. There are 5 figures (1 sketch showing heat
resistance of cross-linked polyethylenes), 1 table and
15 references: 9 English, 3 German, 2 Soviet and 1 French.

ASSOCIATIONS: Výskumný ústav káblov a izolantov, Bratislava
(Research Institute for Cables and Insulating
Materials, Bratislava) ✓
Chemický ústav Slovenskej akadémie vied, Bratislava
(Chemical Institute of the Slovak Academy of Sciences,
Bratislava)

SUBMITTED: March 26, 1960

Card 5/5

23679

15-8101

Z/043/61/000/003/001/001
D222/D305

AUTHORS: Rado, Rudolf, and Lazar, Milan, Engineers

TITLE: Cross-linking of polyethylene initiated by
benzoylperoxide (III) - Formation of cross links

PERIODICAL: Chemické zvesti, no. 3, 1961, 191 - 197

TEXT: This is a continuation of previous studies on cross-linking of polyethylene initiated by free radicals originating during thermal decomposition of benzoylperoxide (R. Rado, M. Lazar, Ref. 1: Chem. zvesti 15, 63 (1961); R. Rado, M. Lazar, Ref. 2: Chem. zvesti 15, 95 (1961)). This paper evaluates the chemism of polyethylene cross linking and expresses, in terms of formal kinetics, whose relations confirm the observed regularities. The decomposition mechanism of benzoylperoxide [Abstractor's note: In the following referred to as BP] is listed in the above references and the limited solubility in organic solvents of cross-linked polyethylene [Abstractor's note: In the following referred to as PE] was used for quantitative determination of the

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Cross-linking of polyethylene...

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D222/D305

cross-linking progress. The degree of cross-linking (γ) and the quantity of cross-links, obtained at various BP concentrations, after various periods, and at different temperatures, are tabulated. In analogy with polymer cross-linking initiated by ionizing and ultraviolet radiation, it is assumed that BP-initiated cross-linking also occurs by recombination of polymer radicals: $PE^\bullet + PE^\bullet \rightarrow PE-PE$. However, as distinct from the radiation-initiated cross-linking, there is no linear relation between the cross-link formation and the concentration of the initiator (BP). This is attributable to reactions which reduce the efficiency of the BP, i.e. induced decomposition and termination (recombination) between the BP radical and the polymer radical, thus competing with the cross-linking reaction itself. These inhibiting reactions have inverted temperature dependence: the non-effective BP consumption caused by induced decomposition drops, that caused by $R^\bullet + PE^\bullet$ recombination rises with increasing temperature. The kinetic equation for the cross-linking process can be derived as follows: The total amount of radicals (PE^\bullet and R^\bullet), originating

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Cross-linking of polyethylene...

during a certain period is $2k_1 [BP] \Delta t$; the amount of PE• radicals is given by the amount of liberated benzoic acid (ΔRH); the amount of R• radicals is given by the difference of these two values. Since each primary radical which is not transferred to a polymer radical, consumes an equivalent amount of polymer radicals for its termination, the total amount of radicals lost by this termination is $2(2k_1 [BP] \Delta t - \Delta RH)$, and only the remaining amount of PE• radicals $2(\Delta RH - k_1 [BP] \Delta t)$ recombines and serves the formation cross-links. Since always two PE• radicals are required to form each cross-link, the total amount of originated cross-links is given by the difference $\Delta RH - k_1 [BP] \Delta t$. After substitution of the expression given for ΔRH in equation 7 (Ref. 2), the equation reads

$$\frac{d [PE - PE]}{dt} = (k_{pr} k_i - k_1) [BP]_t,$$

it

in which $[PE - PE]$ is the concentration of produced cross-links,

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D222/D305

Cross-linking of polyethylene...

and $[BP]_t$ is the concentration of BP at the time t , which can be calculated by a similar formula as valid for spontaneous decomposition:

$$BP = \int_0^t \frac{[BP]_0 \cdot dt}{A(a+1) - a} = \frac{1}{k_1} \{2.303 \log [A(a+1) - a] - k_1 t\}$$

in which $(k_{pr}k_i - k_1)$ is the portion of effective (spontaneous) peroxide decomposition, directly initiating the cross-linking. In the two most extreme cases, the velocity of cross-link formation will be either zero ($k_{pr}k_i = k_1$) or equal to the spontaneous BP decomposition ($k_{pr}k_i = 2k_1$). After substitution for the expression $[BP]_t$ and adjustment, results an equation

$$[PE - PE] = \left(k_{pr} - \frac{k_1}{k_i} \right) \{2.303 \log [A(a+1) - a] - k_1 t\}$$

Card 4/5

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Cross-linking of polyethylene...

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D222/D305

which contains 3 known kinetic constants and expresses the quantity of cross-link formation depending on the initial BP concentration and the reaction time. The calculated values coincide well with experimental results. There are 2 figures, 2 tables and 12 references: 2 Soviet-bloc, and 10 non-Soviet-bloc. The references to the four most recent English-language publications read as follows: L.D. Moore: J. Polymer. Sci, 20, 94, 137-153 (1956); A. Charlesby: Radiation Research 2, 96-97 (1955); E.J. Lawton, J.S. Balwit, R.S. Powell: J. Polymer. Sci, 32, 125, 257-275 (1958); An., Brit. Plast. 31, 399 (1958).

ASSOCIATION: Výzkumný ústav káblov a izolantov v Bratislave (Research Institute for Cables and Insulators, Bratislava): Ústav dreva, celulózy a umelých vlákien Slovenskej akadémie vied v Bratislave (Institute for Wood, Cellulose and Artificial Fibers, Slovak AS, Bratislava).

SUBMITTED: March 8, 1960

Card 5/5

Z/009/61/000/004/003/005
E112/E253

AUTHORS: Rado, Rudolf and Šimůnková, Dagmar
TITLE: Stability of Peroxide Cross-linked Polyethylene
Against Thermo-Oxidative Degradation
PERIODICAL: Chemický průmysl, 1961, No. 4, pp. 209-211

TEXT: The present paper follows on a previous study, describing the preparation and thermo-mechanical properties of a peroxide-crosslinked polyethylene. Attention now is paid to the latter's oxidative degradation under the influence of heat. Crosslinking with peroxides will produce in the parent hydrocarbon a number of tertiary carbon atoms which, it was thought, may have an effect upon the resistance to scission-type reactions. To elucidate this point, the rate of oxidation of three types of polyethylenes was compared: (1) Polyethylene, cross-linked with benzoyl peroxide; (2) polyethylene, also cross-linked with benzoyl peroxide, but with all traces of peroxide or its decomposition products carefully removed, and (3) linear, not cross-linked polyethylene. The rate of oxidation (thermo-oxidative degradation) was established by measuring the rate of oxygen

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Z/009/61/000/004/003/005
E112/E253

Stability of Peroxide Cross-linked Polyethylene Against Thermo-Oxidative Degradation

absorption and duration of the induction period for a temperature range of 135-185°C. Preparation of samples and experimental details are given. A commercial brand of high-pressure polyethylene, "Telcothene" was used. Cross-linking was accomplished by treating powdered "Telcothene" with a solution of benzoyl peroxide in chloroform, evaporating the solvent in the cold and cross-linking by heating 5 hours at 90°C in an atmosphere of nitrogen. Removal of traces of peroxide or its decomposition products was achieved by repeated washing with carbon tetrachloride. Samples of the polymers in powder form were mixed with fine-grained silica (aerosil), placed in a glass-tube and connected through a gas-burette to an oxygen cylinder. The apparatus was thermostatted. Results are summarized in graphs, plotting volume of absorbed oxygen versus time at different temperatures. It is clearly seen that: (a) Decomposition products of benzoyl peroxide are without effect upon the thermo-oxidative stability of polyethylene; (b) decrease in stability is caused by structural changes resulting

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Z/009/61/000/004/003/005
E112/E253

Stability of Peroxide Cross-linked Polyethylene Against Thermo-Oxidative Degradation

from cross-linkages. This is, however, considered insignificant (in the order of 5°C) in view of other advantages which the cross-linked polyethylene offers. There are 6 figures, 2 tables and 8 references: 2 Czech, 1 Soviet and 5 non-Czech.

ASSOCIATION: Výskumný ústav káblov a izolantov, Bratislava
(Research Institute for Cables and Insulating
Materials, Bratislava)

SUBMITTED: June 1, 1960

Card 3/3

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E112/E953

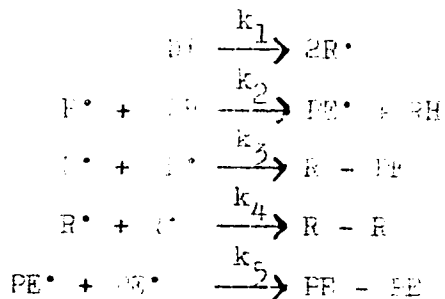
AUTHORS: Šedo, Rudolf and Šimůnková, Dagmar
TITLE: Optimum conditions for the cross-linking of polyethylene with dicumene peroxide
JOURNAL: Chemický průmysl, no.12, 1961, 657-659
TEXT: Technological features and advantages of chemically cross-linked polyethylene and the use of dicumene peroxide as cross-linking agent are discussed. The latter's rate and temperature of decomposition correlate well with processing temperatures of polyethylene, and a high degree of cross-linking can be achieved. The decomposition of dicumene peroxide (DCP) proceeds, even in solvents, by a monomolecular, non-chain mechanism, and the kinetically important individual reaction steps of the cross-linking process can be expressed as:

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Optimum conditions for the ...

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where PEH - polyethylene, P[•] - primary radical from cumene peroxide, PE[•] - polymer radical, R-PE - cross-link. The authors have investigated the effects of time, temperature and BP-concentration on the rates of cross-link formation. They have also determined from A. J. Miller's kinetic equation (Ref. 5: J. Polym. Sci. 4:22, 1950, 241) the rate constant k₃ as ratio of the square root of the primary radical chain concentration and the rate of chain

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for the . . .

$k_4^{0.5}$
 $k_2(PE_{80})$

Experimental part: High-pressure polyethylene was homogenised on a roll mill at 100-110°C with the calculated amounts of DP. Samples were placed into test tubes in a nitrogen atmosphere, which were sealed and heated to 100, 110, 120 and 150°C in a thermostat. Degree of cross-linking was determined from soluble portion of the material in carbon tetrachloride. Its concentration, from degree of cross-linking and the molecular weight (given approximately as 50,000). Results: Temperature had little effect on rate constant k_4 , the numerical value of which remained practically constant at 1.7 ± 0.1 . Temperature has, therefore, little effect on optimum cross-linking conditions. It affects, however, the speed of the vulcanisation process and optimum vulcanisation time for each temperature is given approximately by the time in which 85% of DP becomes k_4 . Most effective concentrations of DP were about 1%, including a cross-linked polyethylene with $3 \cdot 10^{-2}$ moles/kg cross-links, were not reached in the case of high-pressure polyethylene.

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...
... of ... to 16%. Concentrations of DP above ...
... the cross-link ... as a result of ...
... radicals. There are 3 tables, 3
... Soviet Union, 1 a Russian translation
... and 4 non-Soviet- bloc. The
... read as follows: P. 1: Pankovskiy, N.
... J. Polym. Sci. 41, 187 (1959); P. 2:
... 42, 49 (1960); P. 3: Khurash, V.S.
... Org. Chem. 16, 105 (1951); P. 4:
... 12 (1958).

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... Institute for ... and ...
... Bratislava

... 1961

89592

15.8101

S/190/61/003/002/010/012
B101/B215

AUTHORS: Rado, R., Lazàr, M.

TITLE: Process of cross linking in polyethylene caused by peroxide

PERIODICAL: Vysokomolekulyarnyye soyedineniya, v. 3, no. 2, 1961,
310-318

TEXT: The authors studied the process of structurization of polyethylene (PE) by cross linking due to benzoyl peroxide (BP). PE samples containing BP were produced. Undecomposed BP was iodometrically determined after heating in an inert atmosphere; benzoic acid formed by decomposition was alkalimetrically determined; liberated CO_2 was gravimetrically determined. Cross links were calculated on the basis of A. Charlesby's (Ref. 10, see below) ratio between solubility and degree of cross linking. Table 1 gives the data of the BP decomposition in PE. Table 2 those on the formation of cross links. It was concluded that the decomposition of BP is a) continuous (rate constant k_1), and b) induced after reaction of the second order (rate constant k_1). The following equation holds for the

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Process of cross linking...

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total decomposition: $-d[BP]/dt = k_1[BP] + k_i[BP]^2$ (1). Solution of this equation and transformation give $[BP]_t = [BP]_0 / [A(a+1) - a]$ (2), where $A = \exp k_1 t$; $a = k_i/k_1$. k_1 and k_i , and the constant k_t were calculated.

The equation $X_1 = (k_1/k_i) \{ 2.303 \log [A(a+1) - a] - k_1 t \}$ (3) holds for continuous decomposition, $X_2 = (k_1/k_i) \{ (a+1) - A(a+1) / [A(a+1) - a] - 2.303 \log [A(a+1) - a] / A \}$ (4) for induced decomposition; and for k_t :

$k_t = \Delta RH / \{ 2.303 \log [A(a+1) - a] - k_1 t \}$ (8). The constants obtained by calculation are given in Table 4. The calculation of the reaction is

such: $BP \xrightarrow{k_1} 2R^\cdot$; $R^\cdot + BP \xrightarrow{k_2} R^\cdot + CO_2 + RX$; $R^\cdot + PH \xrightarrow{k_3} P^\cdot + RH$;

$P^\cdot + P^\cdot \xrightarrow{k_4}$
 $P^\cdot + R^\cdot \xrightarrow{k_5}$ } products of deactivation; breaking off of the chain re-

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Process of cross linking...

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action. (PH = polyethylene, RH = benzoic acid). The efficiency of cross linking depends on the ratio of the reactions $P^{\cdot} + R^{\cdot}$ and $P^{\cdot} + P^{\cdot}$; in the first case, it is zero, in the second case $k_1 [BP]_t$. The rate of structurization is such: $d[P-P]/dt = (k_i k_t - k_1) [BP]_t$ (9). By substituting $[BP]_t$ in Eq. (2), the following expression is obtained:

$[P - P] - (k_t - k_1/k_i) \{2.303 \log[A(a + 1) - a] - k_1 t\}$ (10). The data calculated and those obtained are compared in Fig. 3. Hence, the following conclusions are drawn: 1) at low temperatures only a breaking off of the reaction occurs due to cross linkage among the polymer radicals; 2) the reaction mechanism changes at higher temperatures. Interaction among primary radicals and the polymer takes place; 3) if the temperatures are still higher, the latter reaction prevails. This is explained by the considerable difference between the activation energy of the independent BP decomposition and that of the transfer, and also by different changes in the reaction rates. BP, which did not decompose monomolecularly, is ineffectively lost. The process of transfer determining the

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Process of cross linking...

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number of cross links among the polymer radicals, plays an important role. The reaction rate also depends on the difficult diffusion of substances in PE. There are 4 figures, 5 tables, and 19 references: 7 Soviet-bloc and 11 non-Soviet-bloc. The 3 references to English language publications read as follows: A. Charlesby, *Atomics*, 5, 12, 1954; H. C. Haas, *J. Polymer Sci.*, 39, 493, 1959; R. Rado, M. Lazar, *J. Polymer Sci.*, 45, 257, 1960.

ASSOCIATION: Scientific Research Institute for Cable and Isolation Material; Chemical Institute of the Slovakian Academy of Sciences, Bratislava

SUBMITTED: October 26, 1960

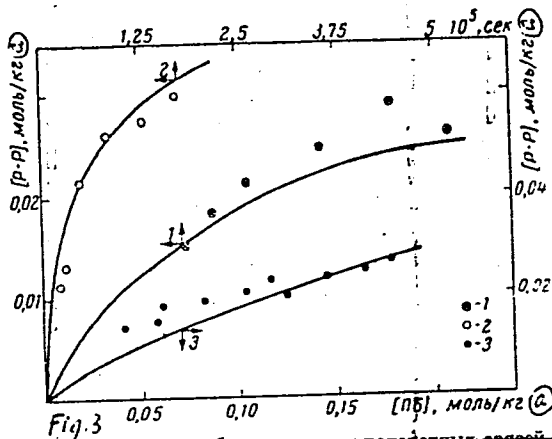
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Process of cross linking...

Legend to Fig. 3:
Content of cross links in dependence
on time and initial concentration of
BP. 1) 70.3°C; 2) 80.1°C; 3) 89.4°C;
solid line: calculated data; dots:
experimental data; a) moles/kg.



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Process of cross linking...

Температура, °C (1)	Время, сек·10 ⁻⁴ (2)	Концентрация переноса бензоила, моль/кг (3)	Расход переноса бензоила, моль/кг (4)	Образовалось бензойной кислоты, моль/кг (5)	Образовалось двуокиси углерода, моль/кг (6)
70,3	8,46	0,0164	0,0044	0,0047	0,0020
		0,0203	0,0063	0,0051	0,0038
		0,0284	0,0082	0,0072	0,0062
		0,0368	0,0153	0,0087	0,0103
		0,0586	0,0272	0,0116	0,0188
80,1	1,44	0,0284	0,0083	0,0079	0,0026
		0,0360	0,0124	0,0086	0,0073
		0,0586	0,0296	0,0184	0,0114
		0,103	0,0555	0,0240	0,0230
		0,116	0,0645	0,0274	0,0364
89,4	0,42	0,0368	0,0174	0,0208	0,0045
		0,0586	0,0324	0,0330	0,0101
		0,103	0,0555	0,0394	0,0276
		0,116	0,0724	0,0529	0,0323
		0,198	0,1145	0,0675	0,0646

Table 1. Decomposition of benzoyl peroxide in polyethylene. Legend: 1) temperature, °C; 2) time, sec·10⁻⁴; 3) concentration of BP, moles/kg; 4) consumption of BP, moles/kg; 5) formation of benzoic acid, moles/kg; 6) CO₂ formed, moles/kg.

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Process of cross linking...

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Температура, °C (1)	Врем., сек·10 ⁻³ (2)	Концентрация переники бензонла, моль/кг (3)	Содержание поперечных связей, моль/кг (4)	Температура, °C (1)	Врем., сек·10 ⁻³ (2)	Концентрация переники бензонла, моль/кг (3)	Содержание поперечных связей, моль/кг (4)	
70,3	1,728	0,116	0,0152	89,4	0,108	0,041	0,0139	
	2,160		0,0184				0,058	0,0150
	2,592		0,0213				0,061	0,0182
	3,564		0,0246				0,082	0,0191
	4,464		0,0289				0,103	0,0208
	5,184		0,0260				0,116	0,0230
80,1	0,216	0,116	0,0112			0,123	0,0220	
	0,288		0,0130				0,144	0,0273
	0,504		0,0214				0,164	0,0252
	0,864		0,0260				0,177	0,0268
	1,296		0,0274					
	1,728		0,0296					

Table 2. Formation of cross links in polyethylene. Legend: 1) temperature, °C; 2) time, sec·10⁻³; 3) concentration of BP; 4) content of cross links, moles/kg.

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Таблица 4

Кинетические константы распада перекиси бензола в полиэтилене

Температура, ① °C	k_1 , сек ⁻¹ ②	k_i , кг·моль ⁻¹ ·сек ⁻¹ ③	k_t , моль·кг ⁻¹ ④
70,3	$1,92 \cdot 10^{-6}$	$1,21 \cdot 10^{-4}$	0,0296
80,1	$1,83 \cdot 10^{-5}$	$4,30 \cdot 10^{-4}$	0,0857
89,4	$1,20 \cdot 10^{-4}$	$1,20 \cdot 10^{-3}$	0,1330
⑤ E, ккал/моль	50,5	28,5	17,3

Table 4. Kinetic constants of decomposition of benzoyl peroxide in polyethylene. Legend: 1) temperature, °C; 2) k_1 , sec⁻¹; 3) k_i (k_{ii} in the original) kg·mole⁻¹·sec⁻¹; 4) k_t (k_{tt} in the original), moles·kg⁻¹; 5) E, kcal/mole.

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AUTHORS: Rado, R., Šimunkova, D.

TITLE: Radical reactions in polyisobutylene initiated by peroxides

PERIODICAL: Vysokomolekulyarnyye soyedineniya, v. 3, no. 8, 1961, 1277-1283

TEXT: The authors dedicated this paper to the effect of the chemical structure of polyolefins on the course of the reaction of macroradicals, and to the possibility of controlling the reaction for the desired polymer transformations. The authors studied radical processes initiated by 99.5 % benzoyl peroxide (BP) on amorphous polyisobutylene (PIB) (molecular weight: $1.3 \cdot 10^6$). PIB samples were synthesized by BP and heated in an inert atmosphere at constant temperature. The following factors were determined: 1) BP consumption; 2) formation of benzoic acid by titration of a CCl_4 solution with 0.01 N reagent; 3) molecular weight of PIB in the course of destruction on the basis of the intrinsic viscosity at 30°C by means of Ubbelohde's viscosimeter according to the equation $[\eta] = 2.9 \cdot 10^{-4} \cdot M^{0.68}$; 4) The number of double bonds by measuring the iodine number of 1 % solutions in CCl_4 . The results obtained at 4 different temperatures are

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Radical reactions...

given in Table 1. The constants K of spontaneous decomposition and K_{ch} of chain destruction are given in Table 2. In accordance with the experimental data the authors found that: 1) the following equation holds for the transfer constant: $k_{tr} = (\Delta [RH]) / 2.303 \log \{ \exp(k_1 t) \cdot [(k_{ch}/k_1) [BP]_0 + 1] - k_{ch}/k_1 [BP]_0 \} - k_1 t$, where $\Delta [RH]$ stands for the amount of benzoic acid; 2) the amount of benzoic acid is approximately equal to the theoretical amount of consumed BP due to spontaneous decomposition to $x_1 = (k_1/k_{ch}) \{ 2.303 \log [\exp(k_1 t) \cdot (k_{ch}/k_1) [BP]_0 + 1] - (k_{ch}/k_1) [BP]_0 \} - k_1 t$. 3) The reduction of the molecular weight follows the equation $M_t = 1000 M_0 / \{ k_d [BP]_c^{0.5} M_0 + 1000 \}$; k_d = destruction constant. The concentration of the double bonds formed is obtained from the equation $[=]_t = (k_{ch} k_{tr} / 2) [BP]_c$

+ $k_d [BP]_c$. On the basis of the data, the authors concluded that: 1) the decomposition of BP, like that of polyethylene, is an induced decomposition of the second order. Benzoate radicals formed by spontaneous decomposition initiate the further decomposition of BP and form polymer radicals; 2) the

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Radical reactions...

transfer reaction is due to the interaction with the methylene groups of the polymer chain and with the substituting methyl groups; 3) part of the polymer radicals with an unpaired electron in the substituent is isomerized due to intramolecular transfer. This causes the destruction of the polymer chain. One of the resulting fragments forms a new polymer radical, and the other is stabilized by the formation of a double bond. The macro-radicals of PIB do not add due to steric inhibition. This causes the formation of double bonds. There are 4 figures, 3 tables, and 8 references: 6 Soviet-bloc and 2 non-Soviet-bloc. The references to English-language publications read as follows: Ref. 4: T. G. Fox, P. J. Flory, J. Phys. Colloid. Chem., 53, 197, 1949. Ref. 5: G. Harvey, L. Klee, J. Amer. Oil Chem. Soc., 27, 127, 1950.

ASSOCIATION: Scientific Research Institute of Cables and Insulating Material, Bratislava

SUBMITTED: February 28, 1961

Card 3/6

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Z/043/61/000/006/002/002
D229/D302

AUTHORS: Lazár, Milan, Engineer, Candidate of Sciences and Rado,
Rudolf, Engineer

TITLE: Cross-linkage of saturated polymers by grafting

PERIODICAL: Chemické zvesti, ¹⁵⁻no. 6, 1961, 435-440

TEXT: One of the possibilities for cross-linking polymers is grafting with a monomer. Cross-links produced by grafting have a different chemical composition from the linear chain. This paper deals with the theory and calculation of the polymerization degree of grafting, especially in view of transfer reactions. The expression for the ratio of cross-linked graft polymer to the total amount of grafted polymer can be derived from the reaction scheme for grafting, listed by M. Lazár (Ref. 2: Chem. zvesti 15, 327 (1961)). According to this reaction scheme, the growth of the branch chains is initiated by transfer reactions from both the growing macroradical (P.) and initiator radicals to the basic polymer (Po). To simplify the calculation, it is assumed

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that the first addition of the monomer to the polymer radical (Po.), the second addition, etc, have the same velocity constants. Cross-linkage by grafting occurs in the termination reaction, but only by recombination. Disproportionation and transfer reactions compete with the cross-linkage. The derivation of the proportion of cross-linked polymer (f_z) is also based on the assumption that the state of free-radical concentration in the system is stationary. (The concentration of radicals can be derived from the concentration of reacting components and the velocity constants of the pertinent reactions). The expression reads then:

$$f_z = \frac{rk_1 P_o^2}{k_1 P_o P_o + k_{1M} P_o M + k_2 P_o^2 + 2rk_1 P_o P + dk_1 P_o P}$$

in which r is the proportion of recombination; and d is the proportion of disproportionation in the termination [Abstracter's note: Other symbols not explained]. After introducing radical concentrations and adjustment, the function reads:

$$f_z = \frac{r(1 - K)\alpha}{1 + \alpha + r\alpha K}, \text{ in which the auxiliary}$$

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symbol $K = \frac{\alpha (C_{Po} + C_M M) + C_M M(1 + \beta)}{(1 + \alpha)(1 + \beta)(C_{Po} + C_M M)}$; α is the ratio of extinction velocity of polymer radicals (P_o and P .) reacting with each other, to the velocity of polymer radicals reacting with the basic polymer (P_o) and the monomer; C and C_M are transfer constants. Solved for α , the equation reads:

$$\alpha = \frac{v_p^2}{C_{Po}M + C_M^2} \quad \text{in which } \delta = \frac{k_3^{0.5}}{k_2}; \quad C = \frac{k_4}{k_2}$$

$C_M = \frac{k_{4M}}{k_2}$; v_p is the total velocity for monomer consumption; and β is

the ratio of the velocity for initiator radicals reacting with the basic polymer to that for initiator radicals added to the monomer. The portion of the cross-linked graft polymer increases at higher ratios of recombination velocity to total termination velocity and lower values for K . Cross-linkage reaches a maximum at $K = 0$ and is zero at $K = 1$. The value for f_z also strongly depends on the value for α , since the cross-linkage requires the transfer which enables the origin

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of polymer radicals $Po\cdot$; however, the transfer reaction itself competes with the recombination reaction, during which the cross-linkage takes place. The optimum value for α , corresponds exactly to the maximum for f_z . The dependence of the f_z value on values for α and β is shown in Fig. 1.

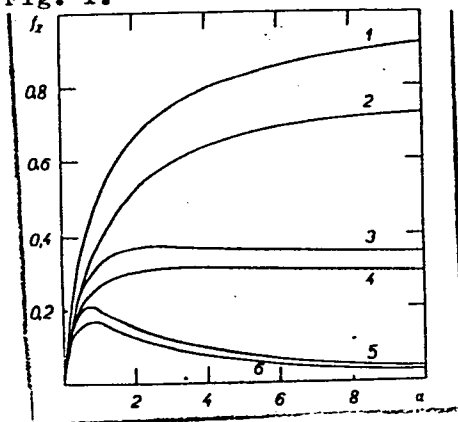


Fig. 1

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According to the present knowledge it can be expected that β values for most polymers will be rather low when initiated by low-molecular initiators. Higher β values can be obtained when the grafting is

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performed with the aid of polymer hydroperoxides. Under the supposition that hydroperoxide groups are bound to the polymer to be grafted, that they are subject to monomolecular decomposition and that the HO· radical initiates homopolymerization, while the macroradical initiates directly the grafting of the branch chain, a value of $\beta = 1$ is obtained.

Fig. 1. Course of the dependence of f_z on α under the assumption that the transfer to the monomer is negligible and that the recombination prevails in the termination reactions ($r = 1$, or 0.8 respectively), at $\beta = 100$ (lines 1 and 2); $\beta = 1$ (lines 3 and 4); and $\beta = 0$ (lines 5 and 6).

Considering a different decomposition mechanism where no monomolecular radicals originate, obtained β values will be very high. As an example for cross-linkage, the authors quote the grafting of a hydrocarbon polymer with styrene. In respect to the prevailing recombination in the termination reaction, the cross-linkage of this monomer seems

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possible. However, when $\beta = 0$, cross-linkage will not take place, because for most grafted polymers, the α values will lie above 10.

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The grafting must therefore be performed with the aid of hydroperoxide. Under optimum conditions ($\beta = 1$), 30 - 35% of the total grafted molecules will be cross-linked. Since during the decomposition of the polymer hydroperoxide according to $R - O - \begin{array}{|c|} \hline O & H \\ \hline \backslash & / \\ & H \\ \hline \end{array} R \rightarrow RO\cdot + R\cdot + H_2O,$

only polymer radicals originate, it should be expected that nearly all of the originating styrene-grafted polymers will be cross-linked. The experimental determination of the f_z value is more difficult than the determination of the cross-linking degree of saturated polymers with direct linkage of linear chains, since it requires the knowledge of the average polymerization degree of both the basic polymer and the cross chains. The difficulty lies in the fact that a cross-linked polymer does not start loosing its solubility before the average number of cross-links exceeds 1/4 of the original polymer chains. In conclusion, the authors state that the cross-linkage obtained by grafting depends, to a large extent, on three ratios, i.e. the ratio of

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D229/D302

Cross-linkage of saturated...

recombination to total termination; the ratio of the termination velocity to the sum of velocities of transfer reactions; the ratio of the velocity of the initiator-radical reaction with the basic polymer to the velocity of the initiator-radical addition to the monomer. There are 1 table, 1 figure, and 4 references: two Soviet-bloc and two non-Soviet-bloc. The references to English-language publications read as follows: T.G. Fox and S. Gratch, Ann. N.Y. Akad. Sci. 57, 367-383 (1953); A. Charlesby, Proc. Roy. Soc. A 222, 542-547.

ASSOCIATION: Ústav drava, celulózy a chemických vlákien Slovenskej akadémie vied v Bratislava (Institute for Wood, Cellulosis and Chemical Fibers, Slovak AS, Bratislava) (Lazár); Výzkumný ústav káblov a izolantov v Bratislave (Institute for Cables and Insulators, Bratislava)(Rado)

SUBMITTED: May 23, 1960

Card 7/7

RADO, R.; SHIMUNKOVA, B.; MALYAK, L.

Degradation and linking of polypropylene under the action of peroxides. *Vysokom.soed.* 4 no.2:304-311 F '62. (MIRA 15:4)

1. Nauchno-issledovatel'skiy institut kabeley i izolyatsionnykh materialov, Bratislava, Chekhoslovatskaya Sotsialisticheskaya Respublika.

(Propene) (Peroxides)

S/190/62/004/011/014/014
B101/B144

AUTHOR: Rado, R.

TITLE: Kinetics of peroxide-initiated reactions of saturated hydrocarbon polymers

PERIODICAL: Vysokomolekulyarnyye soyedineniya, v. 4, no. 11, 1962, 1746-1751

TEXT: On the basis of the reactions $i \xrightarrow{k_1} 2R^\cdot$, where i is the initiator (peroxide), R^\cdot is the peroxide radical; $R^\cdot + PH \xrightarrow{k_2} P^\cdot + RH$, where P^\cdot is the polymer radical, $R^\cdot + i \xrightarrow{k_3} R^\cdot + iX$; $P^\cdot + i \xrightarrow{k_4} R^\cdot + RP$; $P^\cdot \xrightarrow{k_5} P_n + P^\cdot$; $P^\cdot + P^\cdot \xrightarrow{k_6} P_n$; $P^\cdot + P^\cdot \xrightarrow{k_7} \dots$ products of the macroradical disproportionation and $R^\cdot + R^\cdot \xrightarrow{k_8} \dots$ products of recombination or disproportionation of the free radicals, a kinetic equation was derived for concurrent cross linking and degradation of saturated hydrocarbon polymers:

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Kinetics of peroxide-initiated ...

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B101/B144

$$\frac{d[n]}{dt} = \frac{k_3}{\left[\left(\frac{k_0 + k'_0}{k_1 [i]} \right)^{0.5} + \frac{k_4 k_8^{0.5} [i]^{0.5}}{k_1^{0.5} k_2 [PII]} + \frac{k_7}{k_2 [PII]} \right]^2} - \frac{k_5}{\left(\frac{k_0 + k'_0}{k_1 [i]} \right)^{0.5} + \frac{k_4 k_8^{0.5} [i]^{0.5}}{k_1^{0.5} k_2 [PII]} + \frac{k_7}{k_2 [PII]}} \quad (16)$$

The following expression is obtained for the change $\Delta[n]$ occurring in the concentration of the links

$$\Delta n = K_c \frac{2,303 \lg \left[e^{k_1 t} \left(\frac{k_n [i]_0 + 1}{k_1} \right) - \frac{k_n [i]_0}{k_1} \right] - k_1 t}{k_n} - K_n \left\{ \frac{2,303 \lg \left[e^{k_1 t} \left(\frac{k_n [i]_0 + 1}{k_1} \right) - \frac{k_n [i]_0}{k_1} \right] - k_1 t}{k_n} \right\}^{0.5} \quad (24)$$

where K_c is the cross linking constant, K_n is the constant of the peroxide decomposition chain mechanism, K_3 is the degradation constant of the polymer. The values obtained from this equation for polyethylene in which practically only cross linking takes place, and for polyisobutylene in Card 2/3

Kinetics of peroxide-initiated ...

S/190/62/004/011/014/014
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which only degradation takes place, and for polypropylene in which cross linking and degradation occur simultaneously, are in good agreement with the experimental data. There are 1 figure and 1 table. The most important English-language reference is R. Rado, M. Lazár; J. Polymer Sci., 53, 67, 1961.

ASSOCIATION: Nauchno-issledovatel'skiy institut kabeley i izolyatsionnykh materialov Bratislava (ChSSR) (Scientific Research Institute of Cables and Insulating Materials Bratislava (CSSR))

SUBMITTED: April 9, 1962

Card 3/3

RADO, Rudolf

Directed polypropylene destruction. Chem prum 12 no.4:209-212 Ap '62.

1. Vyzkumny ustav kablov a izolantov, Bratislava.

Z/043/62/000/001-2/001/002
D291/D304

1.9.62

AUTHOR: Rado, Rudolf, Engineer

TITLE: Conversions in polyolefins initiated by peroxides

PERIODICAL: Chemické zvesti, ¹⁶⁻no. 1-2, 1962, 44 - 55

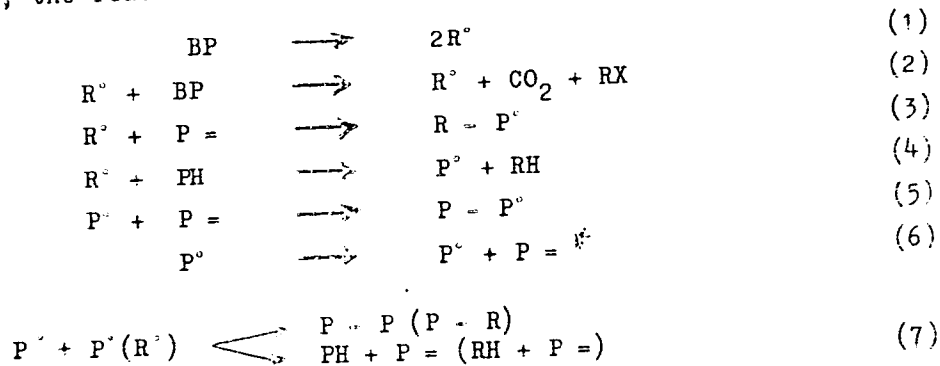
TEXT: The article investigates the laws governing peroxide-initiated reactions in polyolefins, namely polyethylene, polyisobutylene, and polypropylene. The method of studying these processes is described as well as the mechanism and kinetics of radical reactions in polyolefins, and possibilities of controlling the polymer degradation process. The author bases his studies on Western sources, describing the influence of heat and ionizing radiation on polymers, and uses the thermal dissociation of benzoylperoxide for initiating macromolecule conversions, a method which permits separating the initiation stage from subsequent reactions, and thus leads to quantitative conclusions. The benzoylperoxide dissociation was performed in the native state at temperatures ranging from 60 to 90°C, and the peroxide con-

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Z/043/62/000/001.2 /001/002
D291/D304

Conversions in polyolefins ...

sumption and the amount of originating carbon dioxide and benzoic acid were analyzed. It was thus possible to determine the kinetics and the mechanism of macromolecule reactions which are merely elementary stages (transfer and termination) of the peroxide dissociation process. Generally, the reaction scheme can be formulated as follows:



Card 2/4

Z/043/62/000/001-2/001/002
D291/D304

Conversions in polyolefins . . .

* [Abstractor's note: Obviously a misprint and should read 2P' -- P-P']
where BP is the benzoylperoxide molecule, PH the polyolefin, P a polymer chain with unsaturated bond, R[•] a benzoyloxy radical, P' a polymer radical, RH benzoic acid, RX the peroxide dissociation product, R-P' the addition product of the primary radical to the polymer double bond, P - R the interaction product of the primary and the polymer radical, and P-P a cross bond. The reaction in polyethylene results in cross-linkage, because the polymer degradation, i.e. isomerization on the secondary carbon, is inhibited by the rather high recombination rate of polymer radicals due to steric conditions. The reaction in polyisobutylene causes isomerization by intramolecular transfer and rupture of C-C bonds in the main chain. It finally results in degradation, since polyisobutylene radicals, for spacial reactions, have a greater tendency towards disproportioning than towards recombination. The reaction in polypropylene causes both degradation and cross-linkage, and finally results in branched chains; however, an insoluble fraction, as in polyethylene reaction, cannot develop since the formation of each side branch requires an equivalent amount of C-C bond to be broken. A control of

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X

Conversions in polyolefins ... Z/043/62/000/001-2/001/002
D291/D304

macromolecule degradation (isomerization) is possible by addition of a component, against which the polymer radical exhibits great reactivity, e.g. oxygen or sulfur. However, additional heating is necessary to obtain cross-linkage, since the sulfur, under milder reaction conditions, causes only stabilization of macroradicals. The simultaneous addition of peroxide and sulfur permits thus the cross-linkage of polypropylene and even polyisobutylene. There are 11 figures and 33 references, 12 Soviet-bloc and 21 non-Soviet-bloc. The references to the 4 most recent English-language publications read as follows: F.A. Bovey, The Effects of Ionizing Radiation on Natural and Synthetic High Polymers, New York 1958; J.W. Breitenbach, H. Frittm, J. Polymer Sci. 29, 120, 565 - 571 (1958); A. Todd, J. Polymer Sci. 42, 139, 223 - 247 (1960); A.A. Miller, J. Polymer Sci. 42, 140, 441 - 454 (1960).

ASSOCIATION: Výzkumný ústav káblov a izolantov v Bratislave (Research Institute of Cables and Insulating Materials in Bratislava)

SUBMITTED: June 28, 1961

Card 4/4

X

33390

S/190/62/004/002/021/021
B101/B110

11.2210 also 2209

AUTHORS: Rado, R., Shimunkova, D., Malyak, L.

TITLE: Destruction and structuralization of polypropylene under the action of peroxides

PERIODICAL: Vysokomolekulyarnyye soyedineniya, v. 4, no. 2, 1962, 304-311

TEXT: The authors studied the transformations of atactic polypropylene (PP) (MW 54,000; content of double bonds 0.0763 moles/kg), that are caused by benzoylperoxide (BP) in the range 65 - 87°C. The methods employed and the mathematical equations are described in Vysokomolek. soyed., 3, 310. 1277, 1961. The amount of benzoic acid formed and the double bond content of PP were determined. The authors calculated the constant k_1 of molecular decomposition, the constant k_{ch} of chain decomposition, the constant k_t of chain transfer and their activation energies E: X

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B101/B110

Destruction and structuralization ...

$^{\circ}\text{C}$	k_d, sec^{-1}	$k_{ch}, \text{kg}\cdot\text{mole}^{-1}\cdot\text{sec}^{-1}$	$k_t, \text{mole}\cdot\text{kg}^{-1}$
65.0	$8.35\cdot 10^{-6}$	$8.60\cdot 10^{-6}$	0.442
73.0	$1.68\cdot 10^{-5}$	$5.18\cdot 10^{-5}$	0.338
80.0	$1.99\cdot 10^{-5}$	$1.24\cdot 10^{-4}$	0.213
87.0	$1.96\cdot 10^{-4}$	$8.96\cdot 10^{-4}$	0.135
E.			
kcal/mole	29.8	49.5	-14.5

It was found that the MW and the double bond content decrease at low BP concentrations. At high BP concentrations they first decrease and then again reach their original value. At low BP content destruction occurs, at high content structuralization occurs as a result of polymer radical recombination. The constant k_d of destruction and the constant k_s of structuralization were calculated:

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33390

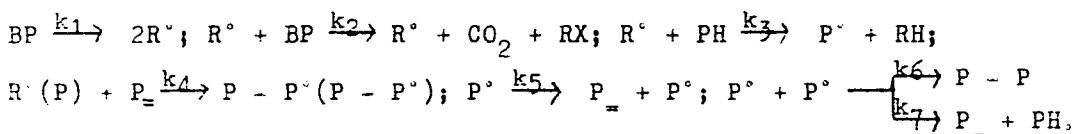
S/190/62/004/002/021/021

B101/B110

Destruction and structuralization ...

°C	$k_d, \text{mole}^{-0.5} \cdot \text{kg}^{-0.5} \cdot \text{sec}^{-1}$	k_s, sec^{-1}	$(k_1 - k_s), \text{sec}^{-1}$
65.1	$1.23 \cdot 10^{-4}$	$8.91 \cdot 10^{-7}$	$7.46 \cdot 10^{-6}$
73.0	$1.67 \cdot 10^{-4}$	$1.84 \cdot 10^{-6}$	$1.50 \cdot 10^{-5}$
80.0	$8.70 \cdot 10^{-4}$	$1.57 \cdot 10^{-5}$	$1.42 \cdot 10^{-5}$
87.0	$3.89 \cdot 10^{-3}$	$1.14 \cdot 10^{-4}$	$2.50 \cdot 10^{-5}$

The following conclusion is made for the transformation mechanism of PP:



BP is the benzoyl peroxide, PH polypropylene, P is the polymer chain with double bonds; R is the benzoate radical; P is the polymer radical; RH is benzoic acid; RX is the peroxide decomposition product; R - P[•] is the product of the addition of the benzoate radical to the double bond of the

Card 3/4

Destruction and structuralization ...

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polymer. P - P is the product of polymer radical recombination. As is the case with polyethylene and polyisobutylene the monomolecular decomposition of peroxide is accompanied by a chain reaction with induced decomposition. There are 4 figures, 3 tables, and 8 references: 2 Soviet and 6 non-Soviet. The four references to English-language publications read as follows:
A. R. Shultz, P. J. Roth, G. B. Rathmann, J. Polymer Sci., 22, 495, 1956;
F. A. Bovey, The effects of ionizing radiation on natural and synthetic high polymers, New York, 1958, pp. 90 - 96; F. B. Waddington, J. Polymer Sci., 31, 221, 1958; R. M. Black, B. J. Lyons, Nature, 180, 1346, 1958. ✓

ASSOCIATION: Wissenschaftliches Forschungsinstitut für Kabel und Isoliermaterial, Bratislava (ČSR)(Scientific Research Institute for Cable and Insulating Material, Bratislava (ČSSR))

SUBMITTED: July 7, 1961

Card 4/4

Z/009/63/000/001/006/006
E112/E435

AUTHORS: Gömöry, I., Rado, R.

TITLE: Chemical modification of polymers

PERIODICAL: Chemický průmysl, ¹³⁻no.1, 1963, 54-55

TEXT: This conference, organized jointly by ČSAV (CzechoslovakAS) - oddelenie polymérov SAV (Department of Polymers SAS), Chemická fakulta Slovenskej vysokej školy technickej (Chemistry Division of the Slovak Technical High School) and Cable and Insulating Materials Research Institute, was held in Smolenice from 12 - 15 September 1962. The conference was attended by 70 Czechoslovak and 35 foreign experts. The programme was divided into 2 sections: Section I - New methods for the production of graft and end-to-end polymers, introduced by Professor Rogovin, Moscow. The individual papers are not listed. Discussions, generally, ranged over the following fields: principles of graft polymerisation by irradiation of vinylacetate on polymethacrylate and styrene, methylmethacrylate on polytetrafluoroethylene and polyvinyl alcohol; modification of rubber, polypropylene and polymethylmethacrylate by graft and end-to-end copolymerisation; ✓
Card 1/2

Z/009/63/000/001/006/006
E112/E435

AUTHORS: Gömöry, I., Rado, R.

TITLE: Chemical modification of polymers

PERIODICAL: Chemický průmysl, ¹³⁻no.1, 1963, 54-55

TEXT: This conference, organized jointly by ČSAV (CzechoslovakAS) - oddelenie polymérov SAV (Department of Polymers SAS), Chemická fakulta Slovenskej vysokej školy technickej (Chemistry Division of the Slovak Technical High School) and Cable and Insulating Materials Research Institute, was held in Smolenice from 12 - 15 September 1962. The conference was attended by 70 Czechoslovak and 35 foreign experts. The programme was divided into 2 sections: Section I - New methods for the production of graft and end-to-end polymers, introduced by Professor Rogovin, Moscow. The individual papers are not listed. Discussions, generally, ranged over the following fields: principles of graft polymerisation by irradiation of vinylacetate on polymethacrylate and styrene, methylmethacrylate on polytetrafluoroethylene and polyvinyl alcohol; modification of rubber, polypropylene and polymethylmethacrylate by graft and end-to-end copolymerisation; ✓
Card 1/2

RADO, Rudolf, inz., CSc.

Mechanism of initiation of polymer changes by peroxides.
Chem zvesti 17 no.9:648-655 '63.

1. Vyzkumny ustav kablov a izolantov, Bratislava, Tovarenska
- 12.

RADO, Rudolf

Stereohybridization of polypropylene. Chem prum 14 no.4:192-194
Ap '64.

1. Research Institute of Cables and Insulators, Bratislava.

LAZAR, Milan; RADO, Rudolf; GOLDBERG, G.M. [translator];
REINHART, V. [Reinohl], inzh., retsenzent; TOMIC, F.,
retsenzent; YEMANOV, S.A., red.

[Fluoroplasts. Translated from the Slovak] Ftoroplasty.
Moskva, Energiia, 1965. 303 p. (MIRA 18:4)

RADO, Rudolf, inz., C.Sc.

Data on the decomposition mechanisms of benzoyl peroxide in
polymers. Chem zvesti 19 no.1:46-50 '65.

1. Research Institute of Cables and Insulators, Bratislava,
Tovarenska 12.

RADO, R., SZOOS, F.; LAZAR, M.

Disappearance of macroradicals in peroxide initiated transformations of hard polymers. Coll Cz Chem 30 no.3:894-897 Mr '65.

1. Forschungsinstitut für Kabel und Isolierstoffe und Laboratorium der Polymere, Slowakische Akademie der Wissenschaften, Bratislava.
Submitted November 15, 1962.

L 3515-66

EPA(s)-2/EWT(m)/EPF(c)/EPA(w)-2/EWP(j)/EWP(t)/ENF(b)/EWA(c)
JD/WH/JW/JND/RM

IJP(c)/RPL

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BOOK EXPLOITATION

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B+1

Lazar, Milan; Rado, Rudolf; Kliman, Norbert

Fluorocarbon plastics (Ftoroplasty). Moscow, Izd-vo "Energiya," 1965.
303 p. illus., biblio. 3300 copies printed. Translation of
Fluoruhlikove plasticke latky. Bratislava, SVTL, 1960.

TOPIC TAGS: copolymer, fluorocarbon plastic, fluorocarbon polymer,
polyfluoroethylene resin, polymerization technology, polymer prop-
erty, polytetrafluoroethylene, polytrifluorochloroethylene

PURPOSE AND COVERAGE: This book is intended for personnel in indus-
tries producing plastics and electrical insulation. The authors
present the physical and chemical background of various fluoro-
carbon plastics, discuss raw materials, polymerization technology,
polymer properties, and describe the use of manufacturing equipment
and efficient production methods in this field. They thank engin-
neers V. Reinohl and F. Tomis. Many references, mainly Western,
accompany most of the chapters.

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Ch. 4. Processing of Polytetrafluoroethylene, ¹⁵ Polytrifluorochloroethylene and Some Other Fluorocarbon Polymers -- 198

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Ch. 6. Brand Names and Economics of Fluorocarbon Plastics -- 293

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L 3515-66

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OTHER: 507

PC

Card 3/3

L 7704-66 EWP(j)/T RPL WW/RM

ACC NR: AP6000913

SOURCE CODE: CZ/0043/65/000/001/0046/0050

AUTHOR: Rado, Rudolf (Engineer, Candidate of sciences)

44.55 50 B

ORG: Research Institute for Cables and Insulating Materials, Bratislava (Vyskumny ustav kablov a izolantov)

TITLE: Mechanism of decomposition of benzoyl peroxide in polymers

SOURCE: Chemické zvesti, no. 1, 1965, 46-50

TOPIC TAGS: polymer, benzoyl peroxide, reaction mechanism, thermal decomposition, polymethylmethacrylate

ABSTRACT: Decomposition of benzoyl peroxide in polymethylmethacrylate at 79.8°C was investigated. The kinetic character of the reaction indicates a chain reaction of the peroxide decomposition, with an induced decomposition of a higher order. Different ways of possible interpretation of this reaction are discussed. Orig. art. has: 3 formulas, 2 figures. [JPRS]

SUB CODE: 07, 11 / SUBM DATE: 27Aug64 / OTH REF: 008 / SOV REF: 004

Card 1/1

L 31402-66 EWP(111) NM/WH
ACC NR: AP00211

SOURCE CODE: CZ/0043/65/000/010/0792/0796

AUTHOR: Rado, R. (Engineer; Candidate of sciences; Bratislava)

64
E

ORG: Research Institute for Cables and Insulating Compounds, Bratislava (Vyskumny ustav kablov a izolacii)

TITLE: Changes of molecular weight and polymethylmethacrylate initiated by benzoyl peroxide

SOURCE: Chemical Abstracts, vol. 10, 1965, 792-796

TOPIC TAGS: polymethylmethacrylate, benzoyl peroxide, molecular weight, chemical decomposition, hydrocarbon, chemical bonding

ABSTRACT: Changes of molecular weights were studied by means of viscosimetric methods. Increasing concentration of the peroxide increases the decomposition of both polymers. Relations between the structure of saturated hydrocarbon chains and their tendency to form intramolecular Lewis is discussed. Study was conducted at 80°C. Orig. art. has: 2 figures.

SUB CODE: 07 / NM DATE: 15May65 / ORIG REF: 005 / OTH REF: 006
SOV REF: 001

Card 1/1 CC

RAXO, T.

Basic problems of Hungarian cartography. p. 174, GEODEZIA ES
KARTOGRAFIA. (Allami Foldmeresi es Terkepeszeti Hivatal) Budapest,
Vol. 8, No. 2, 1956

SOURCE: East European Accessions List (EEAL) Library of Congress,
Vol. 5, No. 11, November 1956

RADO, S.

Role of the UN in international direction of cartography. p. 174,
GEODEZIA ES KARTOGRAFIA. (Allami Foldmeresi es Terkepeszeti
Hivatal) Budapest, Vol. 8, No. 2, 1956

SOURCE: East European Accessions List (EEAL) Library of Congress,
Vol. 5, No. 11, November 1956

RADO, S.

Changes on maps. p. 178, GEODENZIA ES KARTOGRAFIA. (Allami Foldmeresi es Terkepeszeti Hivatal) Budapest, Vol. 8, No. 2, 1956

SOURCE: East European Accessions List (EEAL) Library of Congress,
Vol. 5, No. 11, November 1956

RADO, S.

International cartography. p.281.
(Geodezia es Kartografia, Vol. 8, no. 4, 1956, Budapest, Hungary)

SO: Monthly List of East European Accessions (MEAL) 13. Vol. 6, no. 9, Sept. 1957. Uncl.

RADO, S.

Hungarian maps. p. 10 Vol. 11, No. 17 Sept. 1956. MUSZAKI ELET.
Budapest, Hungary.

SOURCE: East European List, (EEAL) Library of Congress Vol. 6, No. 1
January 1956.

1957, 3.

The standardization of writing geographical names on maps, p. 104 (Geografia es Kartografia Vol. 6, no. 3, 1956 Budapest)

SO: Monthly List of East European Accession (EMAL) LC, Vol. 6, no. 7, July 1957. Uncl.

1957, 1.

The German cartography situation on a small scale. p. 71.
(GEOGRAPHIA. Vol. 9, no. 1/2, 1957, Hungary)

81: Monthly List of East European Accessions (SEAN) no. Vol. 6, no. 12, Dec. 1957.
incl.

RADO. S.

Success and tasks of Soviet geodesy and cartography.

P. 146 (geodezia es Kartografija. Vol.9, no. 3, 1957, Budapest, Hungary.)

Monthly Index of East European Accessions (EMAI) LC. Vol. 7, no. 2,
February 1958

RADO. S.

Cartographic conference held in Stockholm.

P. 183 (Geodezia es Kartografla. Vol. 9, no. 3, 1957, Budapest, Hungary)

Monthly Index of East European Accessions (EIAI) LC. Vol. 7, no. 2,
February 1958

... RADO, S.

Tasks and methods of theoretical cartography.

P. 192. (Geodezia es Kartografila . Vol. 9, no. 3, 1957, Budapest, Hungary)

Monthly Index of East European Accessions (EFAI) LC. Vol. 7, no. 2,
February 1958

RADO, 30

Series of international lectures on the technique of cartography in Munich.

P. 191 (Geodezia es Kartografia. Vol. 9, no. 3 1957, Budapest, Hungary)

Monthly Index of East European Accessions (FEAI) LC. Vol. 7, no. 2,
February 1956

RAA, S.

Some information on the preparation of the Soviet World Atlas.

p. 195 (Geodizia. Vol. 9, no. 3, 1957. Budapest, Hungary)

Monthly Index of East European Accessions (MEMI) 10. Vol. 7, no. 2,
February 1958

RADO, S.

SCIENCE

PERIODICALS: ~~ACTA ZOOLOGICA Vol. 10, No. 2, 1958~~
GEODEZIA ES KARTOGRAFIA Vol. 10, No. 3, 1958

Rado, S. The Magyarország atlasza (Atlas of Hungary) on the agenda. p. 201

Monthly List of East European Accessions (SEAI) LC, Vol. 8, No. 2,
February 1959, Unclass.

RADO, S.

SCIENCE

PERIODICALS: ~~ACTA ZOOLOGICA. Vol. 10, No. 3, 1958~~

GEODEZIA ES KARTOGRAFIA Vol. 10, No. 3, 1958

Rado, S. Geomorphological mapping in the Soviet Union. p. 222

Monthly list of East European Accessions (EEAI) LC, Vol. 8, No. 2,
February 1959, Unclass.

RADO, S.

SCIENCE

PERIODICALS: ~~ACTA ZOOLOGICA Vol. 10, No. 3, 1958~~
GEODEZIA ES KARTOGRAFIA Vol. 10, No. 3, 1958

Rado, S. Cartography at the 18th International Geographical Congress. p. 224

Monthly list of East European Accessions (EEA) LC, Vol. 8, no. 2,
February 1959, Unclass.