THE INFLUENCE OF EXTERNAL FACTORS ON THE FUNCTIONAL PROPERTIES OF PRODUCTS OBTAINED FROM HIGH-MOLECULAR COMPOUNDS

Jerzy Kwiatkowski
The Division of Commodity Science of Industrial Articles

1. Introduction

The Division of Commodity Science of Industrial Articles was established in the Department of Commodities Science in 1954.

The staff together with the head of the department Professor M. Durski assumed the evaluation of quality of products based on high-molecular compounds, modifications of their properties, waste utilization, and protection of raw materials and ready products from negative changes during exploatation to be the main research project. Assuming that science of commodities is an applied science, and its research results should be implemented, a wide range work carried out has always had practical significance.

The first analysis of a profound economic meaning was the preparation of the process and the project of waste utilization in cork and insulating material industry. A combination product of cork discards of various granulation with polyvinyl chloride resin was obtained, a product showing very interesting technical, functional and aesthetic qualities [1, 2].

Research has been carried out concerning the dependence between polymer, flexibilizer and filler, the results of which have been applied in processing industry of polyvinyl chloride [3-10].

Research has been also initiated into the usability and adaptation determination of some analytic methods to evaluate properti of plastics and lacquered products based on highmolecular compounds [11-20].

In relation to the more and more popular use of plastics, research aimed at determination of usability of such materials for packaging was initiated [21-29].

Since 1964 systematic evaluation of natural rubber for tyre industry has been made. Assessment criteria of that raw material were developed and implemented on the basis of technical requirements, which allowed to eliminate sorts not suitable for tyre production [30]. There was as well research and technical assessment carried out for rubber industry concerning new types and sorts of natural rubber and synthetic rubbers [31-32].

Post-production and post-use waste products consititute a serious problem for rubber industry. Therefore research has been carried out on their optimal utilization through reclaiming [33-35] and on application of granulated rubber as an additive to rubber composition [36].

2. Protection of rubber products against negative influence of external factors

The development of motorization induces a vast demand for rubber products. Hence the production of synthetic rubbers increases. World production of that raw material amounted to
5.890.0 thousand tons in 1970 (Poland 61.6 thousand tons);
9.165.0 thousand tons in 1986 (Poland 116.1 thousand tons);
9.4000.0 thousand tons in 1987 (Poland 119.0 thousand tons).
The production of natural rubber increases only slightly which is caused, among other factors, by a limited area of cultivation, and amounted to 4.655.0 thousand tons in 1987 [37].

Plastics and rubber based on natural and synthetic polymers are susceptible to destructive influence of aggressive agents of the atmosphere and environment in which they are used. Therefore it is necessary to protect them accordingly. This task is executed by various protective substances also called stabilizers. They very often act selectively protecting against a specific destructive influence (photostabilizers, thermostabilizers, antioxidants, etc.). In practice in industry mixtures of various protective substances are used, being more effective and universal, and also often acting synergically. The expanding variety of new fundamental materials in plastics industry requires constant evaluation and effectiveness control over protective substances used.

For many years the influence of kinds and amounts of stabilizers on ageing resistance of rubber vulcanizates has been assessed in the Institute of Commodity Science of Industrial Articles in co-operation with tyre industry [38-42].

In recent research special attention has been paid to the possibility of developing a quick method which would facilitate the effectiveness evaluation of protective action of stabilizers (43). Natural rubber vulcanizates type RSS-1 were made of standart mixtures KN-1 without stabilizers and containing 1.3 or 5 parts by weight of chosen protective agents: PBN (phenyl-β-naphtylene amine), TDHQ (tetramethylene dihydrochinoline) and IPPD (isopropyl paraphenylen-diamine) to 100 part by weight of rubber. The vulcanizates were subjected to ageing in natural atmospheric conditions and in xenotest. Traditional examinations of changes in resistance properties were used as a criterion of evaluation. Infrared spectroscopic examination using the ATR reflection technique has also been suggested. This method seems to be very

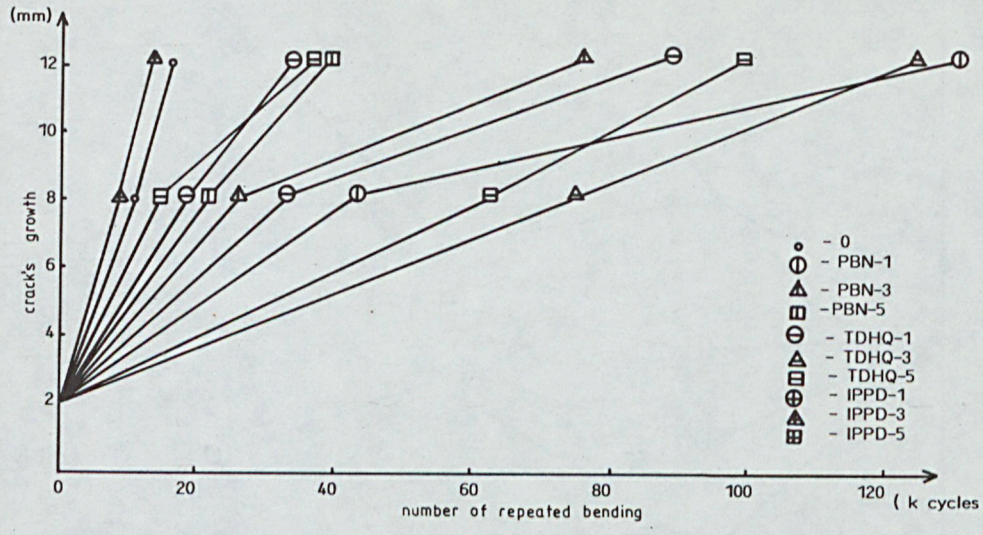


Figure 1. The increase rate of scratch during repeated bending at the temperature od 293 K

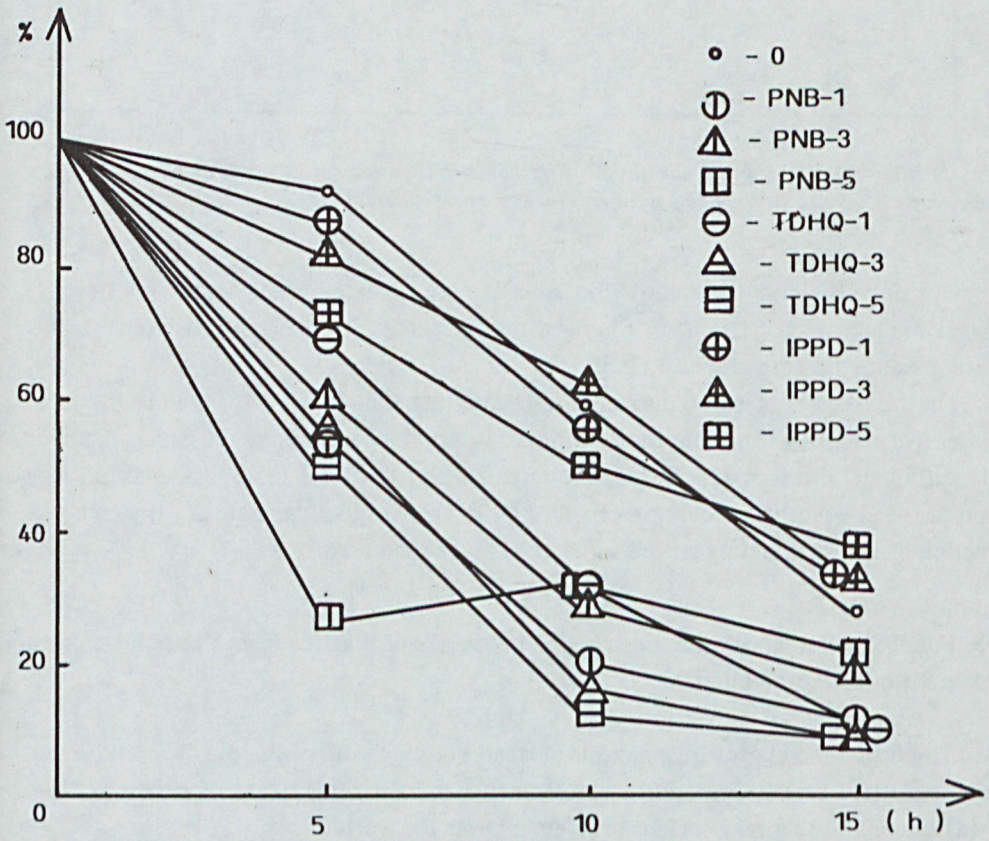


Figure 2. Percentage absorbance changes of CH groups in ATR spectrums of vulcanizates aged in xenotest

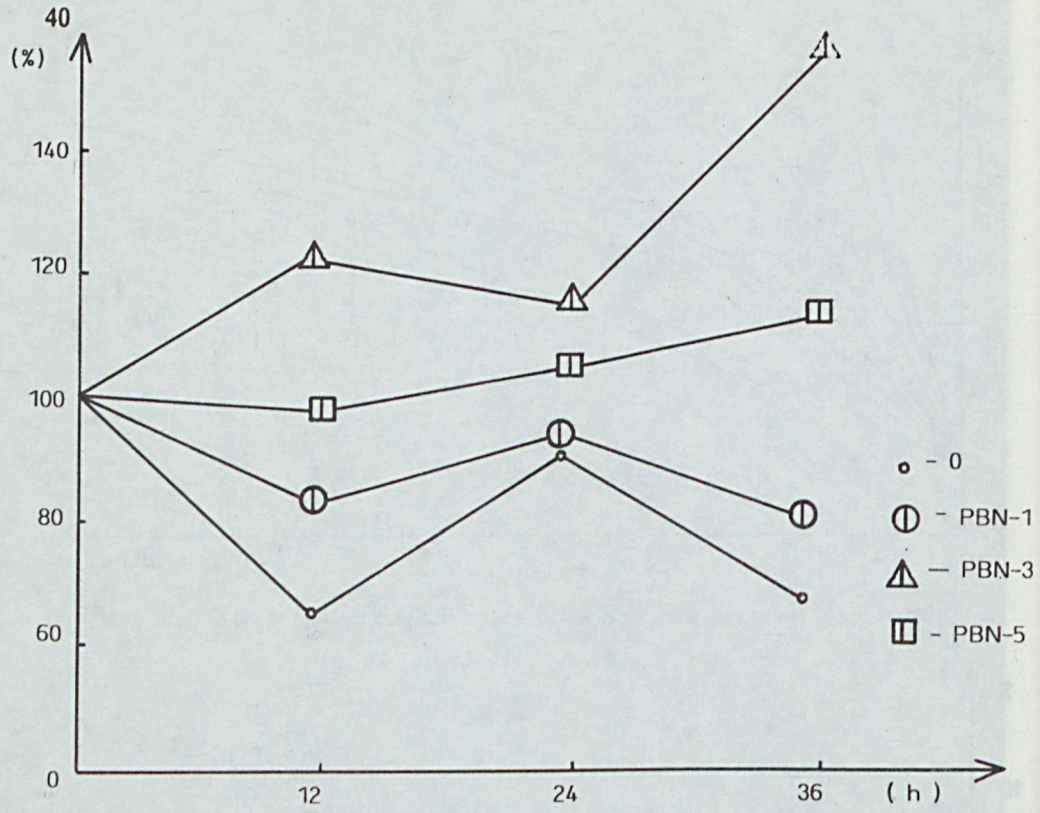


Figure 3. Percentage absorbance changes of CH groups in ATR spectrums of vulcanizates: stabilizer-free and containg 1, 3 oraz 5 parts of PBN stabilizer aged at the temperature of 373 K

useful since it allows to examine the same sample repeatedly not destroying its physical and chemical structure. Changes taking place during ageing of vulcanizates are presented on the graphs 1, 2, 3.

On the basis of research carried out we may say that IPPD and PBN are the most effective stabilizers and that the addition of 1 part of stabilizer per 100 parts of rubber is sufficient. Infrared spectroscopic analysis using the ATR technique may also be proposed as a method to observe changes taking place in vulcanizates or the complex action of external factors on the superficial layer structure.

3. Possibilities to accelerate destructive processes of plastics from the point of view of environment protection

The formation of growing amounts of wastes is the result of the plastics production increase and their more and more common use in various areas of economy. The wastes constitute a very serious problem all over the world.

One of the main ways to use plastics is the production of packaging which are a special threat to natural environment since they are discarded when emptied. Polyethylene showing very good functional qualities is mainly used for packaging. Post – use wastes are deposited in the natural environment and remain there for a long time because of their usual high chemical resistance.

Hitherto existing plastics waste disposal methods (incineration, dumping, composing, etc.) are not very efficient and they are also offen energy-consuming. Thus methods are being sought which would cause accelerated polymer decomposition after it has been utilized by the user and which decomposition products would be physiologically neutral. One of such methods is that of photodegradation. Polymers may gain photodegrading properties by the introduction of modifiers accelerating their decomposition in the presence of sunlight. Among many compounds which may serve the function of accelerating polymer degradation process, organic combinations of metal were found suitable [44-46].

A few types of polyethylene sheeting, modified by ferric stearate, were obtained which undergo accelerated degradation under the influence of external factors. Obtained modified sheetings, although in the beginning showing increased resistance parameters in comparison with control sample foils made of pure polyethylene, nevertheless undergo very rapid destruction later on.

The durability regulation process of polyethylene may be steered by the amount changes of modifying agent and by the addition of an appropriate amount of stabilizer of the polymer.

Durability examination of modified polyethelene sheetings showed that, for the most convenient composition of modyfying agents, 4-week exposition in the natural environment conditions leads to their self-destruction.

The degradation degree evaluation of modified polyethylene was made on the basis of basic resistance qualities and weight-average molecular weight determinations. Due to the simple dependence of ultimate unit elongation changes at rupture on the undergoing decomposition of modified polyethylene in the process of ageing, this property measurements are assumed as the degradation changes discrimant. The reaction of modified polyethylene sheetings is presented on graph 4. Polyethylene modification method using photodegradation accelerating agents may facilitate the decrease and liquidation of plastics packaging wastes burdensome for the environment.

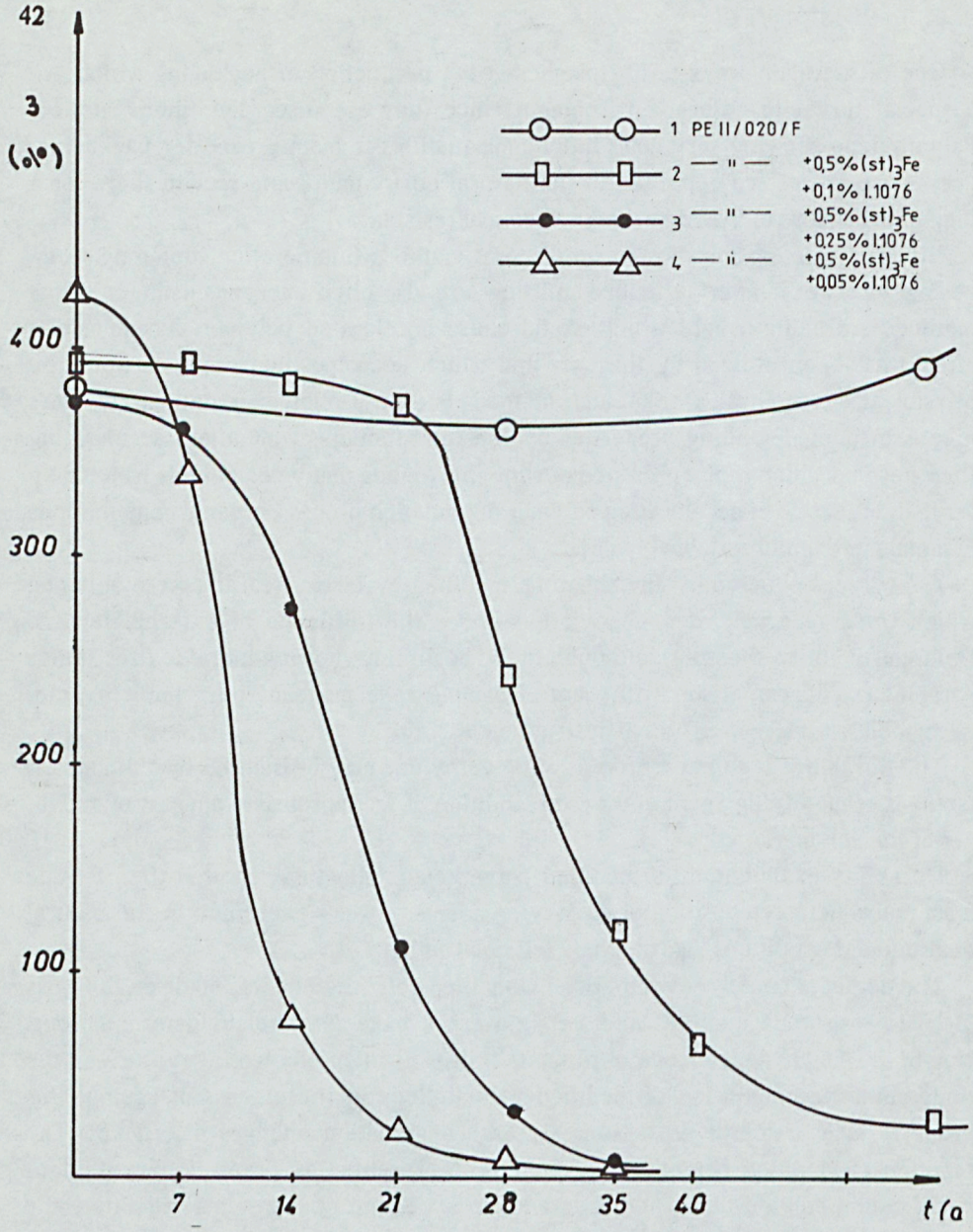


Figure 4. The ultimate unit elongation at rupture dependence on the time length of natural ageing for non-modified foil (1) and sheeting modified with ferric stearate (2, 3, 4)

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WPŁYW CZYNNIKÓW ZEWNĘTRZNYCH NA WŁAŚCIWOŚCI UŻYTKOWE WYROBÓW OTRZYMANYCH ZE ZWIĄZKÓW WIELKOCZĄSTECZKOWYCH

Jerzy Kwiatkowski
Zakład Towaroznawstwa Artykułów Przemysłowych

Streszczenie

W opracowaniu przedstawiono zarys działalności naukowo-badawczej Zakładu Towaroznawstwa Artykułów Przemysłowych od chwili jego utworzenia w 1954 r. Działalność ta obejmuje ocenę jakości wyrobów opartych na związkach wielkocząsteczkowych, modyfikacji ich właściwości, wykorzystania odpadów oraz zabezpieczenia surowców i wyrobów gotowych przed niekorzystnymi zmianami w czasie użytkowania.

W ostatnim okresie skoncentrowano się na problemie ochrony wyrobów gumowych przed niszczącym działaniem czynników zewnętrznych przez stosowanie odpowiednich systemów wulkanizujących i układów stabilizujących, wykorzystując dla oceny efektów tego działania metody tradycyjne i spektroskopię w podczerwieni.

Innym problemem badawczym jest modyfikacja tworzyw opakowaniowych w kierunku przyspieszenia procesu ich degradacji w naturalnych warunkach atmosferycznych i tym samym ochrony środowiska naturalnego przed zaśmiecaniem odpadami.

ВЛИЯНИЕ ВНЕШНИХ ФАКТОРОВ НА ПОТРЕБИТЕЛЬНЫЕ СВОЙСТВА ИЗДЕЛИЙ ПОЛУЧЕННЫХ ИЗ МАКРОМОЛЕКУЛЯРНЫХ СОЕДИНЕНИЙ

Ежи Квятковски
Отделение товароведения промышленных товаров

Резюме

В разработке представлена научно-исследовательская деятельность в Отделении товароведения промышленных товаров с момента его основания в 1954 году. Эта деятельность охватывает оценку качества изделий из макромолекулярных соединений, модификацию их свойств, использование отходов и предохранение сырья и готовых изделий от отрицательных изменений во время эксплуатации.

В последнее время исследования концентрируются на проблеме защиты резиновых изделий от разрушительного воздействия внешних факторов путём применения соответствующих систем вулканизации и стабилизирующих систем, используя для оценки результатов этого воздействия традиционные методы и инфакрасную спектроскопию.

Другим исследовательским вопросом является модификация упаковочных материалов в направлении ускорения процесса их распада в естественных атмосферных условиях и тем самым защиты окружающей среды от засорения отходами.