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РОЗДІЛ 2

**ХІМІЧНІ, ФІЗИЧНІ ТА МАТЕМАТИЧНІ МЕТОДИ
ДОСЛІДЖЕННЯ ПРОЦЕСІВ ТА АПАРАТІВ**

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RECONSTRUCTION OF THE HYSTERESIS LOOP IN FERROELECTRIC POLYMERS

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Polarization (P) in ferroelectric polymers depends non-linearly on the field strength (E), so that the $P(E)$ function is presented by a hysteresis loop typical for all ferroelectrics [1]. Determination of the coercive field (E_c) and the residual polarization (P_r) from this dependence is important not only for selection of poling parameters, but also for estimation of piezoelectric and pyroelectric properties of poled films.

In order to obtain the $P(E)$ function correctly, one should consider some important features. The commonly used Sawyer-Tower's method is not applicable in the case of ferroelectric polymers, because Maxwell's relaxation time is in the range of hundreds seconds [2]. Therefore, measurements must be performed at infra-low frequencies. Besides, it is necessary to extract the polarization component of the total poling current and to separate it from other two components corresponded to capacitive and conductive currents. Moreover, in calculations of the $P(E)$ function, one must consider a finite apparent resistivity and cannot take the value of the dielectric constant (ϵ) from reference books, because of its strong frequency dependence, while the listed values correspond usually to the frequency of 1 kHz. All these features have not been consistently accounted so far, although attempts were made repeatedly to obtain $P(E)$ hysteresis loops in ferroelectric polymers.

It is worthwhile to mention that almost all data on the $P(E)$ hysteresis in ferroelectric polymers were obtained by direct application of voltage to electroded samples, while it is general practice now to use corona for their poling [3]. We developed a new method to obtain the $P(E)$ dependence from experimental kinetics of the electret potential during the initial constant current corona poling, as well as during repeated poling and switching of polarization in the corona of the opposite polarity, but under the same value of the poling current. We use a true value of the dielectric constant in our calculations and do not neglect the apparent conductivity, obtaining the both parameters during the same poling experiments. As an example, the $P(E)$ dependence for polyvinyl fluoride (PVDF), a typical ferroelectric polymer, was obtained and values of the coercive field and the residual polarization were found.

We used extruded and uniaxially stretched PVDF films of 25 μm thickness electroded on one side by evaporation of Al in vacuum and subjected to a constant current poling in a corona triode with a constant potential of -3 kV applied to the vibrating grid. By processing experimental curves we found that $P_r=42 \text{ mC/m}^2$ and $E_c=48 \text{ MV/m}$. Switching of polarization took about 1800 s meaning that one hysteresis loop was completed in one hour, i.e. the equivalent frequency of the measurement was $2.8 \cdot 10^{-4} \text{ Hz}$.

Scientific Advisor – Prof. A. E. Sergeeva, DSc (Physics & Mathematics)

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MINT DRYER CAPACITY OF 10 KG IN THE FINISHED PRODUCT PER HOUR

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Different taste and aromatic substances contained in fruits and vegetables are of great importance in human nutrition. They significantly improve the taste of food, which contributes to its understanding.

Most fruits and vegetables can not long be kept fresh. They deteriorate as a result of exposure to enzymes and microbes. Long-term storage of fruits and vegetables may help with drying.

The research object is drying cabinet that is constructed from analogue of domestic production and consists of two parts top – and bottom pyramid – in the form of a rectangular parallelepiped.

The design is completely made of standard grades. For smaller heat insulation and dryer separately, which significantly reduces power consumption.

The upper cabinets installed channel fan that provides full supply of the required amount of air in the drying chamber after passing electric.

As a result of the settlement was set optimal operation which involves heating the air temperature to 60 °C, air flow up to 112 kg/h, and the drying about 4 hours, (cube measuring 10×10 mm).

Also had a decisive relatively small size cabinet that can create its installation in limited areas of operation.

To repair the air system nodes do not need to spend maximum effort as components are easily accessible which greatly reduces labor costs and reduces downtime.

In these settings dryer capable of drying vegetables provided that they are washed, cut (cubes or slices) and lined with a thin uniform layer.

These meal (dried vegetables) may serve as a good addition to meals, because with a relatively long shelf life.

Particular attention should be paid to this production at the winter time, and plus a set of dry rations to soldiers for quick hot meals.

This design has been developed for small and medium enterprises that can meet the needs of consumers in the market and would be able competitiveness with similar foreign production.

Supervisor – Ph.D., Associate Professor Lulka D.M.

THE USE OF GRAPE WASTE Vasko V.	31
ПЕРСПЕКТИВИ ВИКОРИСТАННЯ ЗЕРНА СПЕЛЬТИ ПРИ ВИРОБНИЦТВІ ХАРЧОВИХ, КОРМОВИХ ПРОДУКТІВ ТА БІОПАЛИВА Присяжнюк А.В.	32
IMPROVEMENT TECHNOLOGY POSTHARVEST DRYING OF GRANE MILLET Yurkovskaya V.V.	34
HULLESS BARLEY MULTIFUNCTIONAL FOOD GRAIN Drach A., Lunina L.	36
ТЕХНОЛОГІЧНА ОЦІНКА ЗЕРНА ГІБРИДІВ КУКУРУДЗИ Штефанюк А. М.	37
IMPROVEMENT OF PROCESS OF SOYBEANS CLEANING Lopatkin V.G.	39
ИССЛЕДОВАНИЕ ВЛИЯНИЯ ВНЕШНИХ ФАКТОРОВ НА СОСТОЯНИЕ ЗЕРНА, ХРАНЯЩЕГОСЯ В МЕТАЛЛИЧЕСКИХ СИЛОСАХ Рабович О.Н.	40
ЗМІНА ЯКІСНИХ ХАРАКТЕРИСТИК КУКУРУДЗИ ПРИ ЗБЕРІГАННІ В АНАЕРОБНИХ УМОВАХ Устенко А.Є.	41
ТЕХНОЛОГИЧЕСКИЕ СВОЙСТВА И ПЕРСПЕКТИВЫ ИСПОЛЬЗОВАНИЯ СЕМЯН БЕЗНАРКОТИЧЕСКОЙ ТЕХНИЧЕСКОЙ КОНОПЛИ Бошканяну М.А.	43
РОЗДІЛ 2 – ХІМІЧНІ, ФІЗИЧНІ ТА МАТЕМАТИЧНІ МЕТОДИ ДОСЛІДЖЕННЯ ПРОЦЕСІВ ТА АПАРАТІВ	
DETERMINATION OF THE ECONOMICALLY FEASIBLE INSULATION THICKNESS OF HEAT CONDUCTORS Floreskul O.O.	46
МАТЕМАТИЧЕСКАЯ МОДЕЛЬ НАГРЕВА МАТЕРИАЛА В МИКРОВОЛНОВОМ ЭЛЕКТРОМАГНИТНОМ ПОЛЕ Георгиев Е.В.	48
SIMULATION OF THE NEAREST NEIGHBORHOOD OF PERCOLATION CLUSTERS ELEMENTS Kryvchenko Y.V., Kryvchenko A.A.	49
INTERRELATION BETWEEN SPACE CHARGE AND POLARIZATION IN A POLYMER FERROELECTRIC Sorokina A.G.	50
TWO COMPONENTS OF POLARIZATION IN FERROELECTRIC POLYMERS Sorokina A.G.	51
RECONSTRUCTION OF THE HYSTERESIS LOOP IN FERROELECTRIC POLYMERS Petrovskiy R.V.	52

Наукове видання

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