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Processing of organic waste by electrohydroimpulse method

The article considers the regularities, parameters of technology and installations for electrohydroimpulse extraction of fat from bone mass. To date, the growth of production and increasing its efficiency in industries processing agricultural raw materials largely depends not only on raw materials and their quality, but also on the completeness of extraction of valuable components. Reducing the loss of the extracted product in production, for example, sugar, starch, fat, can significantly increase the yield of finished products when using optimal extraction methods and methods. The result is powerful hydraulic shocks with pressure pulses sufficient to break the bonds, retain fat cells in the tissue and destroy the cells themselves. This article discusses the technology of extracting fat from bones. The priority direction of technical policy in the agro-industrial complex, as well as in the light and food industries, is currently the development of a system of operational and promising measures to provide agricultural producers with high-quality, environmentally friendly, safe and highly reliable equipment. The dominant and extremely unfavorable production conditions force the manufacturer not to process, but to sell raw materials.

Keywords: spark discharge, fat, organic waste, shock wave, crushing, bone mass.

Introduction

The currently existing physical and chemical methods of fat extraction are not effective in terms of economy, labor intensity and ecology. Therefore, the search for new effective solutions for extracting fat from bone mass using alternative methods, including underwater spark discharge, is relevant at the moment.

Our proposed method is based on the use of a pulsed shock wave resulting from a spark discharge in a liquid. This method of extracting fat does not require fine grinding of the bone. The discharge-pulse technology makes it possible to successfully solve and is widely used in the technological processes of cleaning castings, metal stamping, fixing pipes in the pipe boards of heat exchangers, processing industrial waste in order to extract valuable phosphorus components from phosphorus sludge, crushing mineral media and separating impurities from various kinds of crushed materials, etc. [1, 2].

The existing physical and chemical methods of oil extraction are economically inefficient, labor-intensive and environmentally friendly. Therefore, the search for new effective solutions for obtaining fat from bone mass using alternative methods, including underwater spark generators, is currently relevant [3].

Our proposed method is based on the use of a pulsed shock wave generated by spark radiation in a liquid. This method of obtaining fat does not require easy grinding of the bone. The exhaust-pulse technology makes it possible to successfully solve and widely apply it in the technological processes of cleaning fabrics, metal stamping, fixing pipes with tubular plates of heat exchangers, extracting valuable phosphorous components from phosphoric clay, grinding mineral media and processing industrial waste into individual impurities of various types of crushed materials, etc [4, 5].

Experimental

An experimental setup was assembled to grind and extract the fat mass from the bone. The influence of an underwater spark of an electrohydroimpulse installation was studied to determine the optimal parameters. Figure 1 below shows the object of the study [6].

Figure 1. The object of the study

The study of fat extraction from cattle was carried out on an experimental electrohydroimpulse installation. Various cattle bones were taken for testing in the sausage shop of JSC "Tulpar" in Karaganda. According to laboratory tests in the workshop, the bones had a low average fat content.

Before the start of the test, 15 kg of bone raw materials were crushed to size $5-10mm$. Certain fractions were weighed on electronic scales. After that, the bone mass was left for 6 hours in a container with industrial water. To determine the mass, after the expiration of time, the soaked bones were weighed [7].

Figure 2 shows an electrohydroimpulse installation for extracting fat from organic compounds.

Figure 2. Electrohydroimpulse unit for extracting fat from organic compounds

Below is Figure 3, which shows the main part of the experimental setup. We immerse the prepared bone mass into the working cell. At a frequency of 7-15 Hz in an aqueous medium, shock waves arise from the impact of pulses and water enters the bone. When exposed to wave waters, the structure of the bone with a fat content is destroyed and the transition of the fat layer into the solution is observed. The frequency limit was determined by testing.

Figure 3. Working cell for separating fat from organic compounds

The bone mass, which is connected to water and heated to a certain temperature, enters the crushing equipment through the receiver of the guide cone and, after the hatch is tightly closed, acts on the shock wave that occurs when the spark is discharged. The intensity of the degreasing process and the possibility of direct wide regulation during the process are achieved by rotating the DIU housing relative to the central electrode [8].

The temperature set during the tests $32-50^0C$ is sufficient to separate fat from bone mass. At low temperatures, less fat 32^0C is retained by the tissue (skin) and destroyed as a result of adsorption and capillaries, at this time the viscosity and surface tension of the oil increase, and the separation of fat slows down. The study showed that the impulses from electrohydroimpulsive effects are enough to destroy the fat cells holding in the tissue [9].

Results and Discussion

Tests on the electrohydroimpulse installation were carried out in the laboratory of Hydrodynamics and Heat exchange of the Karaganda University of the name of academician E.A. Buketov. The objects of the study are the bones of cattle. As a result of the tests, the optimal exposure power and pulse repetition rate are set for each parameter. The bones were previously crushed to fractions of 10 mm, 5 mm and 2 mm.

Based on the experience developed in the installation shown in Figure 2, the results obtained were analyzed and effective parameters were determined. With the help of the installation, they were able to create electrical discharges in a clean liquid and at a given vapor concentration into the mixture. The fixed volume of bone mass in the fluid was 25 % [10, 11].

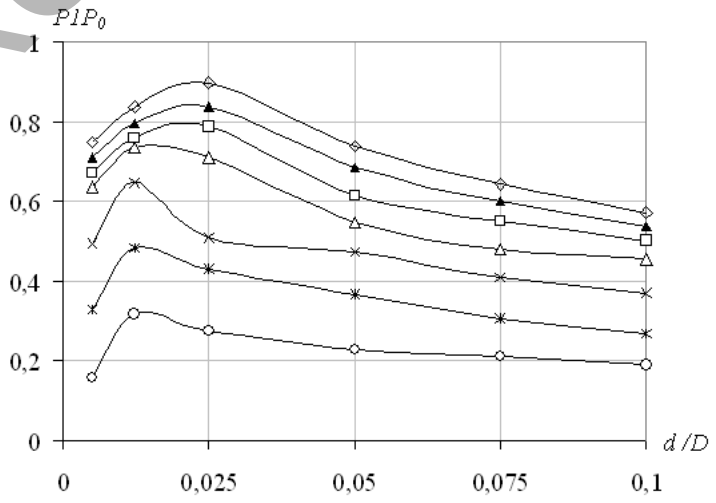

Figure 4. Dependence of the pulse pressure amplitude on the fixed loaded volume of bone mass

As a result of the performed studies, the dependences of pulse pressures for various degrees of vapor content of the working medium are obtained. Experimental work was carried out with fixed electrical and energy parameters of the discharge circuit of the electrohydroimpulse and geometric parameters of the working crushing plant. The variable parameters were the frequency of the supplied pulse and the degree of vapor content.

Figure 5 shows a graph of the effect of the capacitance of the capacitor bank of the electrohydroimpulse device on the fat-free crushed bone at $U = 10kV, \quad l_p = 7mm, \quad t_{\text{mixture}} = 32^0 C$.

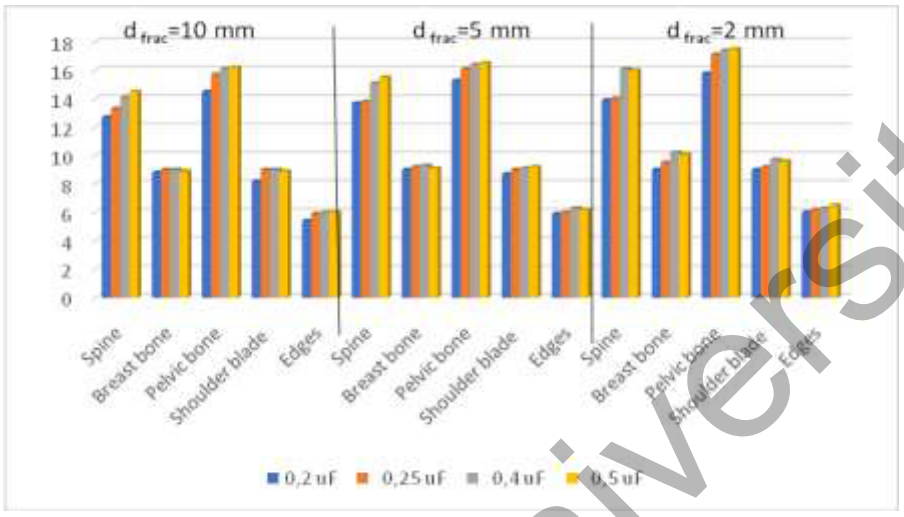

Figure 5. Influence of the capacitance of the capacitor bank of an electrohydroimpulse unit for degreasing crushed bone at $U = 10kV, \quad l_p = 7mm, \quad t_{\text{mixture}} = 32^0 C$

During the study, the voltage was 10 kV, the temperature of the mixture was heated to 32^0C. As you can see on the graph, when grinding the bone to a fraction of 10 mm, the separated fat of the spine was 12.7 %, and during grinding to a fraction of 2 mm was 13.9 %.

The influence of the capacitance of the capacitor bank of the electrohydroimpulse unit for $U = 20kV, \quad l_p = 7mm, \quad t_{\text{mixture}} = 36^0 C$ degreasing crushed bone is shown in Figure 6.

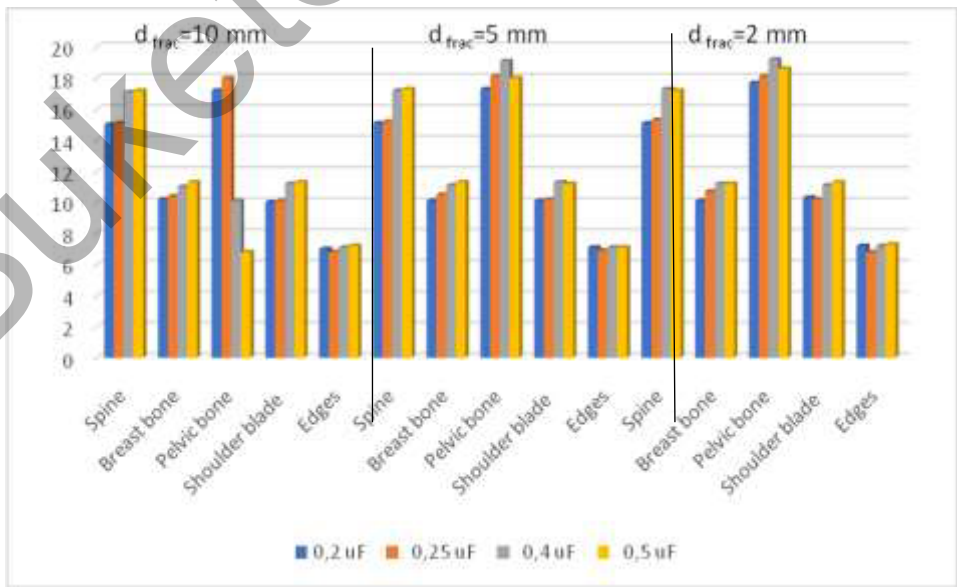

Figure 6. Influence of the capacitance of the capacitor bank of the electrohydroimpulse unit for degreasing crushed bone at $U = 20kV, \quad l_p = 7mm, \quad t_{\text{mixture}} = 36^0 C$

Figure 7 shows the content of the separated fat with an increase in the voltage and temperature of the mixture. According to the schedule, we can say that with an increase in voltage we get good results.

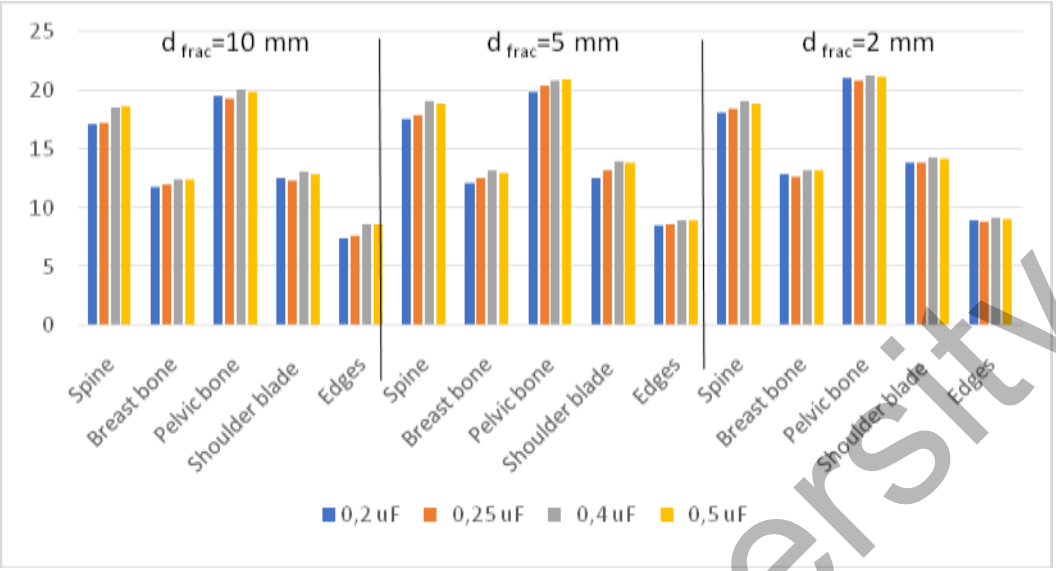

Figure 7. Influence of the capacitance of the capacitor bank of an electrohydroimpulse unit for degreasing crushed bone at $U = 30kV$, $l_p = 12mm$, $t_{\text{mixture}} = 44^0 C$

It can be seen from the figures that with an increase in the capacity of the capacitor bank in energy storage and the length of the discharge gap (l_p), the extraction of fat from bone mass increases, and the intensity of fat removal can stabilize with an increase in capacity. This allows you to select the optimal capacitance values necessary for reproducing experiments.

Based on the research, the optimal parameters of the developed electrohydroimpulse method for extracting fat from bone mass have been determined, where the treatment is carried out in a spark discharge mode with a specific energy of 2,0 104 J / m with a pulse repetition frequency of 10-16 Hz, and the process is carried out at a temperature of $36 - 44^0$ C.

Conclusions

To study the extraction of fat from organic compounds, we developed and assembled an experimental electrohydroimpulse installation, as well as a working cell was assembled. The methodology and conditions for conducting research and the procedure for conducting tests have been developed. The optimal temperature of the mixture was selected in the interval $32 - 50^0 C$ for extracting a valuable component from the bone mass — fat. It was found that at temperatures below $32^0 C$, part of the fat is retained by the skin. As a result of adsorption and capillarity, viscosity and surface fats are reduced, and the extraction process is reduced.

It was found that with an increase in the capacity of the capacitor bank in energy storage and the length of the discharge gap, the extraction of fat from bone mass increases, and the intensity of fat removal stabilizes with an increase in capacity. It was found that with an increase in the capacity of the capacitor bank in energy storage and the length of the discharge gap, the extraction of fat from bone mass increases, and the intensity of fat removal stabilizes with an increase in capacity. Based on the study, the optimal parameters of the developed electrohydroimpulse method for extracting fat from bone mass were determined.

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Органикалық қалдықтарды электрогидроимпульс әдісімен өңдеу

Мақалада сүйек массасынан майды электрогидроимпульс әдісімен алу заңдылықтары, технология параметрлері және қондырғылар қарастырылған. Бүгінгі таңда ауылшаруашылығы шикізатын өңдейтін өнеркәсіп салаларында өндірістің өсуі және оның тиімділігінің артуы көбінесе шикізат ресурстары мен олардың сапасына ғана емес, сонымен қатар құнды компоненттерді алудың артуына да байланысты. Өндірісте өндірілетін өнімнің жоғалуын азайту, мысалы, қант, крахмал, май, өндірудің оңтайлы жолдары мен әдістерін қолдана отырып, дайын өнімнің шығымдылығын едәуір арттыра алады. Нәтижесінде байланыстарды бұзу, май жасушаларын тіндерде ұстау және жасушалардың өзін бұзу үшін жеткілікті қысым импульстары бар күшті гидравликалық соққылар пайда болады. Сонымен қатар мақалада сүйектен май алу технологиясы қарастырылған. Агроөнеркәсіптік кешеннің негізгі міндеті — ауылшаруашылығы өндірісін орнықты дамыту, Қазақстан Республикасының азық-түлік пен шикізатқа қажеттілігін толық қанағаттандыру. Агроөнеркәсіптік кешендегі, сондай-ақ жеңіл және тамақ өнеркәсібіндегі техникалық саясаттың басым бағыты қазіргі уақытта ауылшаруашылығы өндірушілерін сапалы, экологиялық таза, қауіпсіз және сенімділігі жоғары жабдықтармен қамтамасыз ету жөніндегі жедел-перспективалық шаралар жүйесін әзірлеу. Басым және өте қолайсыз өндірістік жағдайлар өндірушіні қайта өңдеуге емес, шикізатты сатуға мәжбүр етеді.

Кілт сөздер: ұшқын разряды, май, органикалық қалдықтар, соққы толқыны, ұсақтау, сүйек массасы.

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Переработка органических отходов электрогидроимпульсным методом

В статье рассмотрены закономерности, параметры технологии и установки для электрогидроимпульсного извлечения жира из костной массы. На сегодняшний день рост производства и повышение его эффективности в отраслях промышленности, перерабатывающей сельскохозяйственное сырье, в значительной мере зависит не только от сырьевых ресурсов и их качества, но и от полноты извлечения ценных компонентов. Сокращение потерь извлекаемого

продукта в производстве, например, сахара, крахмала, жира, может существенно повысить выход готовой продукции при использовании оптимальных способов и методов извлечения. Результатом являются мощные гидравлические удары с импульсами давления, достаточными для удержания жировых клеток в ткани, разрушения связей и самих клеток. В настоящей статье рассмотрена технология извлечения жира из костей. Основная задача агропромышленного комплекса — устойчивое развитие сельскохозяйственного производства, полное удовлетворение потребностей Республики Казахстан в продовольствии и сырье. Приоритетным направлением технической политики в агропромышленном комплексе, а также в легкой и пищевой промышленности в настоящее время является разработка системы оперативно-перспективных мер по обеспечению сельхозпроизводителей качественным, экологически чистым, безопасным и высоконадежным оборудованием. Доминирующие и крайне неблагоприятные производственные условия вынуждают производителя не на переработку, а на реализацию сырья.

Ключевые слова: искровой разряд, жир, органические отходы, ударная волна, дробление, костная масса.

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