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# INNOVATIVE ENVIRONMENTAL PACKAGING FOR SEPARATING STORAGE OF TWO COMPONENTS, ALLOWING TO EXTEND THE LIFETIME WITHOUT PRESERVATIVES

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**Abstract**: A container for separate storage of two components was developed, which allows to increase the functionality and reliability of containers, increase the volume of the container for the additional component and its shelf life, prepare working mixtures immediately before their use, simplify the design, using the standard capacity as a container for one of the components, facilitate assembly containers and its operation. Container elements (container for the main component, core for rupture of the membrane, container for the additional component, protective glass, lid, gasket and membrane) are made using easily recyclable and biodegradable materials.

**Keywords:** container, storage, components, capacity, cover, rod, gasket, membrane, glass, container for the main component, capacity for an additional component.

**Introduction.** It is relevant in the food, chemical, pharmaceutical and medical industries to create containers for two components, which are stored separately from each other for a long time, but are mixed after opening the container immediately before use. Thus, to fully utilize the beneficial properties of drinks obtained from natural ingredients and not containing preservatives, having a very limited shelf life and perishable products, the concentrated blend is stored separately from drinking water in a special container, for example, a container (capsule) and their mixing immediately before use.

A plastic beverage bottle with a capsule is currently known, which is proposed to be welded directly to the neck of the container, like a membrane; in this case, the capsule is made and sized so that it is held with an exact fit, clamping its conical part into the neck of the container or the conical receiving cavity of the welding head; the edge of the capsule is welded to the end of the container neck [1].

The disadvantage of a plastic bottle is the small usable volume of the chamber for ingredients, the lack of a device for opening the capsule, and the lack of a mechanism for removing the opened capsule from the neck of the bottle.

A known package contains a container for the main component, a lid connected to the container, and a container for the injected component located in the upper part inside the container. The container has an opening with a valve. The container and the valve are designed to be movable relative to each other. Clutch elements are made on the container or on the valve. Between the inside of the container and the outside of the container there is a channel for releasing the prepared mixture. A rod with guide elements is installed on the cover, ensuring a specified movement relative to the cover. There is a button at the upper end of the rod. The rod is equipped with a working body, which is designed to interact with the coupling elements of the container or valve [2].

In our opinion, the disadvantage of the known packaging is the complexity of the design, the small volume of the container (capsule), and the device for opening the capsule and mixing the contents of the capsule and the contents of the bottle is complex and low-tech to manufacture.

Previously, a container for two components was developed, including a container with a threaded neck filled with a liquid product, and a capsule with a concentrated product located in the lid of the container. The container lid is made of two parts that form the internal space of the capsule. The first, of which is made in the form of a prefabricated glass, the bottom of which is covered with a membrane made of materials impermeable to concentrated and liquid products. The wall of the glass covers the neck of the container on both sides and is screwed onto the neck. And the second – in the form of two coaxially located pipe sections, united by a common end section, is connected to the first so that the inner pipe section is located inside the glass, and the outer pipe section is located outside the glass, the first and second parts are connected to each other using a spline connection with the possibility axial movement, while the lid is equipped with a two-position locking mechanism, and the internal pipe section is equipped with a sharp edge for opening the capsule [3].

The main disadvantages of the considered container for the two components are: the complexity of the design, assembly and use of the container, and the small usable volume of the chamber for the ingredients.

The goal is to develop innovative and ecological containers for separate long-term storage of two components, preparation of working mixtures immediately before their use, allowing to simplify the design by using a standard container with a volume of 0,33–2,0 liters with a standard screw thread as a container for one of the components, facilitate the assembly of the container and its operation, as well as increase the functionality and reliability of the container, increase the capacity of the additional component and its shelf life.

**Research results.** ***General characteristics of containers for separate long-term storage of two components.*** We offer an innovative and environmentally friendly container for separate storage of two components [4] (Fig. 1), containing a container with

a threaded neck filled with a liquid product (Fig. 2–5), which differs from known developments in that it is additionally equipped with a container that is screwed onto the container and has a corrugated zone in its central part with the possibility of compression, equipped with two necks located in its upper and lower parts, having external and internal threads, respectively, while a rod is inserted into the upper neck, consisting of a heel, the diameter of which is equal to the outer diameter of the neck, and a rod pointed at an obtuse angle, the length of which varies depending on the size of the container, and the lid is screwed on, and the lower neck has a narrowing in the form of a truncated cone with a plug inserted into it with an impermeable membrane fixedly installed in it, having thinnings radially diverging from the center along the edges, fixed by pressing with a threaded connection by the container, while the lower neck of the container and the stopper are made in the form of conical surfaces corresponding to each other, and the container is additionally equipped with a protective cup attached to it.

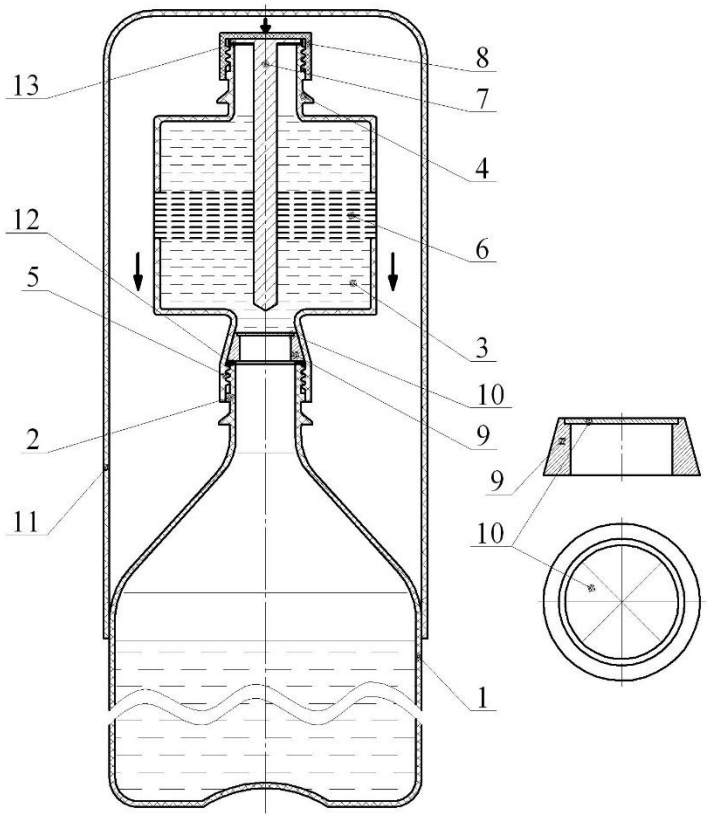



**Fig. 2. Container for separate storage of two components**

You can attach a toy to the container with the main component, which will be located between the protective glass and the container with the additional component. Toys can be varied for boys in the series of toys «Warriors of different countries and eras» (Fig. 6), for girls in the series of toys «Dolls: dolls – girlfriends and dolls in national costumes» (Fig. 7), as well as for little ones in the series of toys «Cartoon characters: characters from domestic cartoons and characters from foreign cartoons» (Fig. 8). In addition, for the adult population and tourists, instead of toys, you can use the series:

national signs and symbols of the Republic of Belarus and their meaning (Fig. 9), series: heraldry of the regions of the Republic of Belarus (Fig. 10). For collectors, we can offer a numismatic series «Coins and banknotes from different countries of the world and eras».

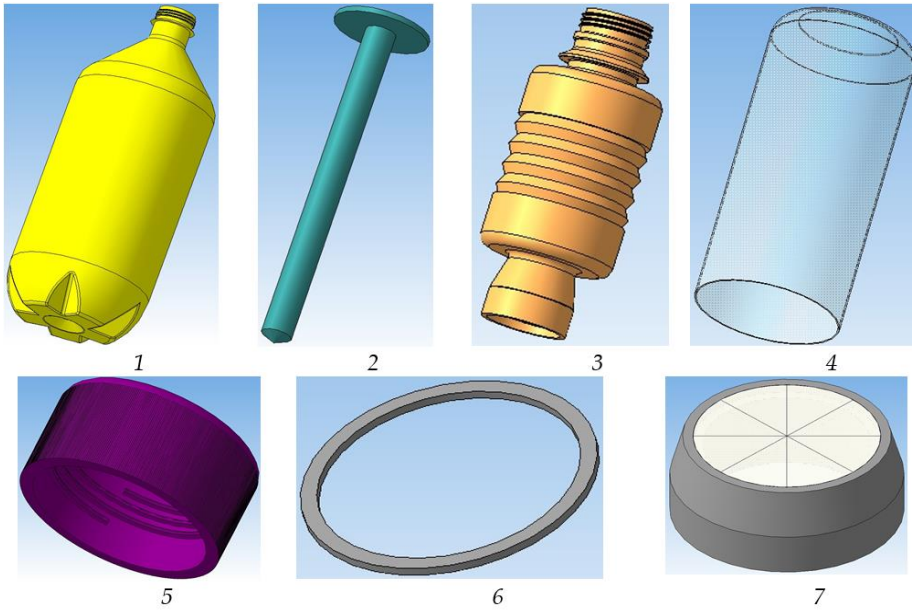



**Fig. 3. The main elements of the container for the separate storage of two components: *1* – the container for the main component, *2* – piercing the membrane rod, *3* – capacity for an additional component, *4* – glass fuse, *5* – cover, *6* – gasket, *7* – membrane**

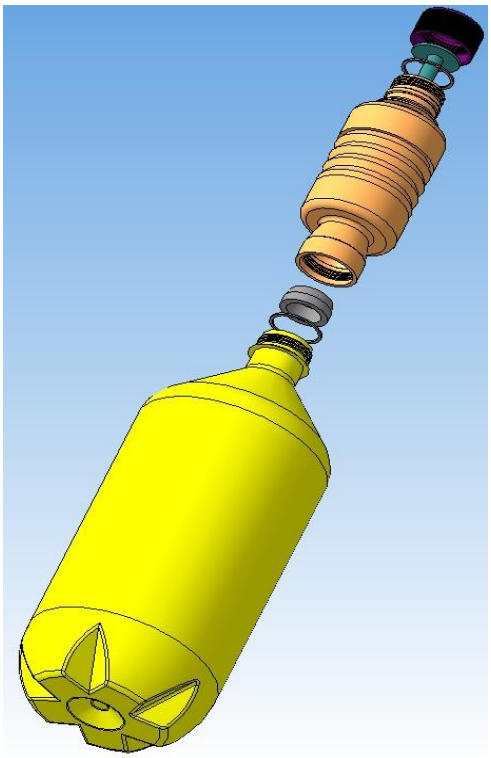


**Fig. 4. General view of the container for the separate storage of the two components without a protective glass**

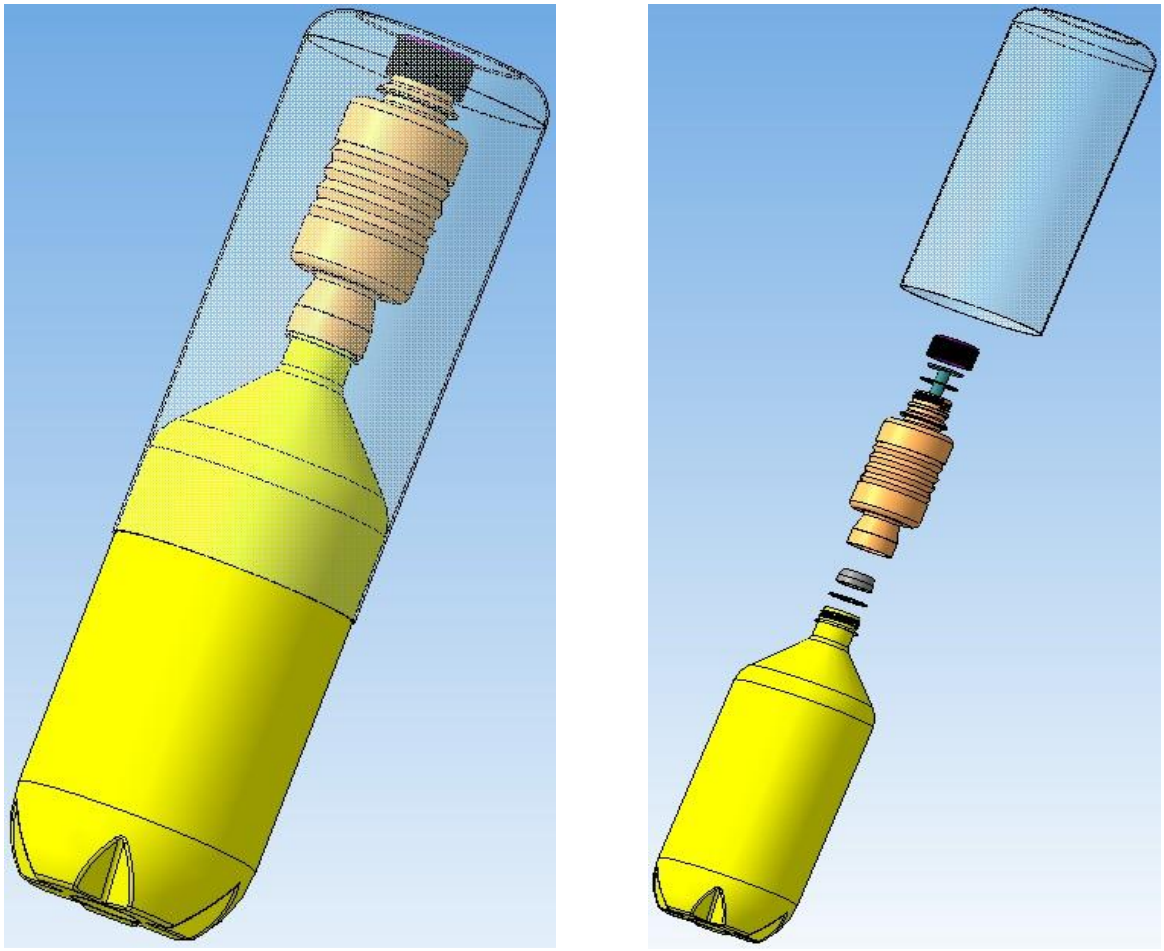
The container for the additional component *3* is connected to the container for the main component 1 through a threaded connection, screwing neck *5* onto neck *2*.

The container for the additional component *3* is equipped with a special corrugated zone *6* in its central part. Due to this, container *3* can be folded under directed vertical mechanical action. The advantage of this technical solution is the ability to extract the additional component as completely as possible from container *3* when it is compressed.

Container *3* can be made of various materials used in the food industry, including biodegradable ones, such as polypropylene, polyethylene terephthalate.

The plug *9* is equipped with an impermeable membrane *10* fixedly installed in it, which has thinning that facilitates its rupture when the container *3* is compressed and radiating radially from the center along the edges, while the lower neck *5* of the container *3* and the plug *9* are made in the form of conical surfaces corresponding to each other.

Cork can be made from various materials used in the food industry, including biodegradable ones, such as polypropylene, polyethylene terephthalate.



*1* *2*

**Fig. 5. General view of the container for the separate storage of two components with a protective glass: *1* – assembled view, *2* – disassembled view**

The membrane can be made of aluminum foil, polyethylene, etc., while the thickness and strength of the membrane is selected taking into account the design of the container.

The plug *9* with the membrane *10* is connected to the container *3* and is fixed by pressing when connecting the container for the main component *3* and the container *1*.

The rod or rod for breaking the membrane *7* is installed inside the upper neck *4* of the container for the additional component *3* and is fixed by twisting the lid *8*.

The lower part of the rod *7* is sharpened at an obtuse angle, which facilitates not only the penetration of the membrane *10*, but also the maximum bending of its edges formed after the rupture.

The stem and cover can be made of various materials used in the food industry, including biodegradable ones, such as polypropylene, polyethylene terephthalate.

For additional sealing of the connections of the container for the additional component *3* with the lid *8* and the container for the main component *1*, sealing gaskets *12*, *13* are provided.

The protective cup *11* is designed to protect the container for the additional component *3* from unintentional compression and premature damage to the membrane *10*. In addition, it is possible to subsequently use it as a glass for consuming the finished product, or as a measuring glass when applying a scale indicating the volume of liquid.

The protective cup is made from various materials used in the food industry, including biodegradable ones, such as polypropylene, polyethylene terephthalate, as well as wood and metal.

The protective cup *11* is fixed to the container for the main component *1* due to their tight fit (rubbing) or using additional fastening, for example, shrink film.

***Dynamic description of containers for separate long-term storage of two components.*** The implementation is as follows.

Filling the container *1* with the main component is carried out through the neck *2*. Then the container for the additional component *3* is screwed onto it with a previously inserted plug *9* and a gasket *12* into the lower neck *5*, thereby ensuring the compression of the plug *9* and additional sealing of the connection.

Filling the container *3* with an additional component is carried out after screwing it onto the container *1* through the upper neck *4*. After filling the container with the additional component *3*, a rod *7*, a gasket *13* are inserted into the upper neck *4* and screwed on with a lid *8*. A protective glass *11* is installed on top and fixed.

Using containers to store two components separately.

Remove the protective cup *11*, press on the upper part of the container with the additional component *3* to break the membrane *10* with the rod *7* and displace the additional component into the container with the main component *1*.

Mix the main and additional components thoroughly by shaking or turning over.

Protective glass *11* is used for consuming the finished product or dosing it.

To reduce the size of the container with the finished product after mixing the components, the container for the additional component *3* can be disposed of, first remove it and use the lid *8* to seal the resulting mixture in container *1*.

An additional component can be a liquid of varying viscosity, powder granules, tablets.

Containers for separate storage of two components can be made from materials known in the industry using known technologies and equipment.

The described container for separate long-term storage of the two components is recommended for storing quickly perishable natural drinks prepared without the use of chemical preservatives. The design and technological features of the proposed container suggest the possibility of separate storage for a long period of time of the components of natural drinks: water in a container for the main component and a blend of a drink with an amount of solids of at least 70% in a container for an additional component. A concentrated blend of a natural drink with a solids concentration of at least 70% and water can be stored in an airtight container for a fairly long period of time (up to 1 year or more) without requiring particularly harsh storage conditions (temperature, humidity, etc.), i.e. proper storage requires standard room conditions.

The widespread and widespread use of the proposed packaging will allow natural drinks to compete in terms of shelf life, as well as consumer characteristics (organoleptic, physicochemical and microbiological properties) with synthetic drinks and drinks that use synthetic preservatives in their formulations that are not always beneficial to human health.

**Conclusion.** Thus, we have developed an innovative, environmentally friendly and easily recyclable container for separate storage of two components with the possibility of inserting a toy, which allows us to increase the functionality and reliability of the container, increase the capacity of the container for the additional component and its shelf life, prepare working mixtures immediately before their use, and simplify the design, using a standard container as a container for one of the components, facilitates the assembly of the container and its operation.

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