

# Large capacity device for hydrocarbon storage and its utilization in geotourism

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## Abstract

Gas storages in large capacity storage devices may help to solve the problem of the gas storage and transport if the storage is safe with the possibility of sure, comfortable and fast enough pumping and charging the battery by stored gases. Such solutions, which can be used as an energy source device in (geo)touristic attractive but lonely locations also, are presented in this article.

**Key words:** large capacity device for gas storage, hydrocarbons, natural gas, natural zeolites, cryogene temperatures

## INTRODUCTION

Natural zeolites are one of the most numerous mineral groups. Nowadays, the term zeolite is used to for relatively large group of approximately 400 inorganic materials, from which more than 60 are of natural origin. From chemical point of view, zeolites are hydrated Al-silicates. Due to their structure, zeolites have unique physical-chemical properties, from which a large internal surface will be used in this paper. Storage of hydrocarbons, e.g. methane, at temperatures lower than their melt temperature allows their storing in the liquid state when lower storing space is required compared to the space needed for storing of the same volume of material in the gas state. Storing of molecules of liquid hydrocarbon on internal structure surfaces of natural zeolite reduces the distances between molecules of stored liquid hydrocarbon what increases the capacity of stored gas volume.

## BRIEF REVIEW OF LARGE CAPACITY DEVICE FOR HYDROCARBON STORAGE

Safe storage of hydrocarbons requires

large capacity containers using cryogenic temperatures and inert substance - such as natural zeolite, with a large internal surface. Such a system can safely store up to 600 times the volume to storage in normal pressure. Innovative is the fact that gas will be cooled below the boiling point, making it liquid. Heat capacity of natural zeolite is large, so that when heated above the boiling point of zeolite stored gas, there is a gradual release. Thermal process can be the key storage - release - storage be managed in real time.

The proposed system is protected by a patent in pilot experiments with different gases and inert substance with large internal surface apparently there is another application of the invention. Project VUKONZE "working" with hydrocarbon gases, thus developed a secure high capacity container.

The automatic large capacity device for energy gases storage (VAZEP) can be used everywhere for safety long-term storage of energy gases and also for their controlled and safe dose for next applications (Rybár & Molokáč, 2012; Molokáč et al., 2013).

## UTILIZATION OF PROPOSED DEVICE IN GEOTOURISM

Utilization of such device requires natural

zeolite cooling under the temperature lower than cryogene (liquefied) stored gas. For example, to store the natural gas it is needed to cool the condensing space under 111,5 K, what is natural gas (methane) melting temperature. For such purposes, it is sufficient to cool natural zeolite to the temperature of liquid (cryogene) nitrogen, which boiling temperature is 77,36 K. Using such devices with the cooling system can represent a long term and safe energy source in distant or outlying areas with no need of infrastructure building or frequent exchange of low capacity gas cylinders containing propane, which is highly explosive mixed with air. Such places are often located in untouched countryside or in highly protected areas, where many geosites or geotourism attractive sites can be identified (e. g. geosites in national parks where infrastructure building is highly limited by the law).

Technical-economic study of the device utilization will define limit values when the investment into large capacity device for natural gas (or other hydrocarbons requiring cryogene temperatures to be stored) storage would be profitable.

## SAFETY OF PROPOSED DEVICE

VAZEP is the technical solution for long term and safe hydrocarbon storage and also allows regulated and safe gas dosing in case of its future use.

Safety of the device use results from the technical solution of the device and use of natural zeolites:

- The device consists of thermally isolated chamber filled by natural zeolite.
- Thermally isolated chamber is connected and disconnected to the cooling reservoir by the thermal key and is equipped by regulated heater to empty the chamber.
- Device output is connected to the energetic gas appliance and input is connected to the source of liquefied

energetic gas.

- The safety is assured by high thermal capacity and inertia of natural zeolites. Therefore, sudden leak of stored gas is not possible because slow warming of zeolites allows only gradual and thus regulated release of stored gas from large capacity device.
- Gases are stored at cryogene temperatures but at conditions of normal pressure.

## CONCLUSION

Proposed device is unique technical solution for lonely and/or outlying geotourism or mining tourism attractive sites with no or limited infrastructure because it is possible to use the device for generation of heat or electricity for the objects located at such sites. The device construction may ensure energy for long-lasting operation within the objects of geosites. Subsequent technical-economic analysis is necessary to specify the conditions of effective use of such investment.

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