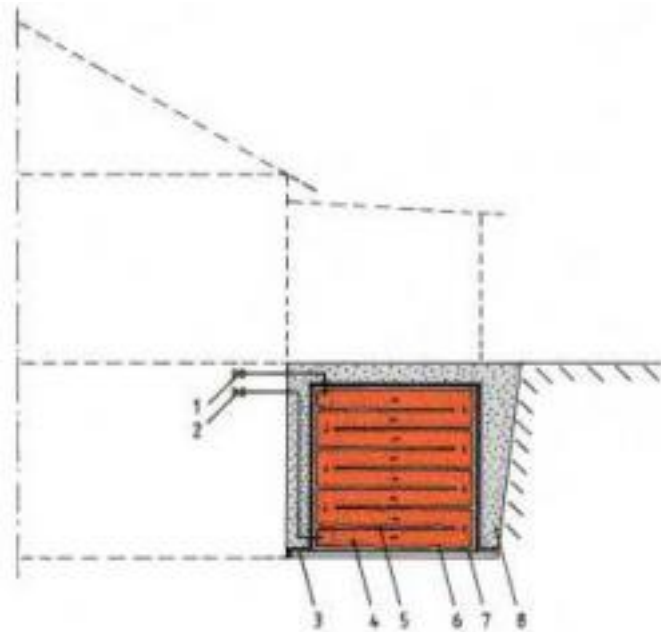


## Pit Heat Store with a Thermal Stratification Direct Water Charging System put up by concrete masonry units

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Pervious concrete filled with water used for constructing centralised or decentralised underground thermal storage units right beneath or nearby residential, industrial or commercial buildings, –strong enough to be build over, environmentally friendly, maintenance-free, storage efficient and cost effective, long lasting, and corrosion resistant- preferably erected with concrete masonry units. -The future key-technology for modern district or unitary renewable and low energy heating & cooling.

### Background:

Buildings of tomorrow require a combination of minimised onsite energy generation incorporating maximised renewable thermal energy sources; ultra-efficient building and insulation materials, and waste heat recovery.

Solar energy is one of those most potential renewable energy sources, which can be used for heating & cooling. Today, solar-thermal collectors are working quite well, but in order to make them more efficient, it is advised to run them with an indoor short-term storage system in combination with a big enough outside mid to long-term thermal storage system to maintain a sustainable and steady thermal energy supply all year round, that means during nights and periods of cloudy (sunless) days too, and in the wintertime (seasonal use). Other sources like the shallow ground heat, the waste heat from untreated wastewater collection systems, from low temperature heating & cooling systems like floor/wall/ceiling heating & cooling systems, and air-conditioning, and the energy from biomass boilers, and micro-cogeneration and heat pumps are further potential alternative heat sources for thermal storing.

So heat storage is an essential part of a very broad range of renewable energy and waste heat recovery options, and is an enabling technology, without it, alternative heating and cooling would not be possible quite sufficient. But it needs as reasonable as possible be installed to become finally cost efficient.

Narrow city right-of-ways and private land space is limited and very expensive, so an underground solution nearby the particular building is generally advised, which uses no open land or interior room space and can be build over. The advantage

of such an underground storage solution is, that it requires less insulation, because the storage system is covered by the particular house and embedded in the ground heat, and that the distance of energy transportation to the user is as short as possible.

#### New Building Material:

Following the above basic demands Orange Depot Systems has developed a new thermal storage building material, which is made of pervious concrete provided as ready-mix concrete or prefabricated concrete masonry units, which can absorb a lot of water in its porous structure.

An advantageous example of application is given by the graphic attached to this article. The meaning of the numbers are as following:

- 1 Hot Water - Inlet
- 2 Cold Water - Outlet
- 3 Sealing & Drainage foil
- 4 Water Flowing Level
- 5 Mortar Layer
- 6 Mortar Sheeting
- 7 Foundation Slab
- 8 Thermal Insulation

Pervious concrete is conventionally known as a special type of concrete with a high porosity that allows water to pass through. The high porosity is attained by a high interconnected void content. Typically it has little to no fine aggregate and has just enough cementitious paste to coat the coarse aggregate particles while preserving the interconnectivity of the voids.

Depending on the necessary weight bearing strength the concrete need to have more or less cementitious paste and is more or less compressed, what makes the concrete heavier or lighter, and has more or less void volume. And the complete void volume defines, how much water can be take in and how much water can flow through its material structure. And the maximum water volume is the major parameter for the maximum heat storage capacity of the whole pit heat store.

But an important criterion for a successful operation of thermal stores in solar assisted heating systems is that the heat generated by solar collectors during the day can be charged into the store in the same time (in combination with a buffer store) during 24 h. Consequently, not only the amount of thermal energy has to be taken into consideration but also the store's maximum thermal power input and output. The disadvantage of stores, which uses an indirect charging system designed similar like a floor heating system arranged in several horizontal levels using plastic piping the length and as a consequence the costs of the plastic piping increases linearly with the size of the store, and is therefore relatively expensive, - and complicated to install. And the maximum thermal power input and output is also relatively low depending on the known low thermal conductivity of the water saturated in the concrete material.

In comparison – now the new building material opens the great opportunity to operate those stores with a direct charging system without a separate piping system by pumping the water directly through the pervious material structure. This provides a very fast thermal charging of the whole store.

And the big advantage of this material solution is that it can be prefabricated as concrete units for masonry. So the whole store can be put up in the pit in tiers and many horizontal levels as like a construction kit by using those concrete units. Each tier of e.g. concrete blocks is bedded in a horizontal layer of a cementitious paste (mortar), which fix the units and seal and keep the levels hydraulically separate to the next. But each layer has one recess along one side located in opposite to the upper and below related layer, so that water can flow down or up from one level to the other only in this area.

The whole store has to be erected on a simple but firm and watertight foundation slab. And before the pit is refilled with excavation the pit store needs also to be made watertight from the outside top and all four sides by a mortar sheeting and a plastic foil, and as necessary be insulated. A good stuff for thermal insulation and to encase the whole storage block is foam concrete for instance.

Depending on how the heating & cooling system of the house is individually designed hot water is let into the top level of the store at the same time the cold water is let out from the bottom level of the store, or cold water is let into the bottom level

simultaneously hot water is let out from the top level. In any case the water circulates through the store vertically and meanderingly from the top to the bottom or from the bottom to the top. So this construction system provides a maximised stretch of water flow and a perfect vertical thermal stratification system.

And this material can be build over without the need to build heavy-duty and expensive structural frame and roof constructions. Those storage units can be flexible placed preferably right under the foundation slab or attached to the house beneath a patio or winter garden on individual request and house building design. So now every new developed real estate or new-built or remodelled or refurbished building or house can have its own individual storage system nearby.

If you like having more details about this new building material and its options for application and use, please contact the address below.

**Realisation & Use:**

The basic idea is patented in Germany and patent-pending world-wide.

The new building material and appropriate shapes of concrete masonry units are in the prototype phase and needs now individually be specified and tailored to final product(s) corresponding on local demands and standardizations.

Orange Depot Systems want to do this and the following marketing and sale by cooperating with appropriate local companies and clients, and providing the necessary consulting support and giving licenses or selling the particular national patent right.

-If this is interesting for you, please contact the address below.

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TEC MANAGEMENT is an engineering and consulting firm in the field of environmental friendly technologies with focus on underground infrastructures, and beside others specialised on alternative energy storage & supply.

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