DETAILS AND EXPERIMENTAL RESULTS OF A STAND-ALONE CONTAINER COOLED BY A SOLAR DRIVEN MULTI-STAGE TRAVELING WAVE THERMOACOUSTIC SYSTEM

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Abstract

Nowadays in many solar rich countries, up to 40% of the electric power is consumed for cooling and air conditioning only. From sustainable and energy point of view this is not a efficient situation, due to many energy conversion steps and energy loses.

A way out from this dead end road is to convert solar heat directly into cold. One technology to perform such action is thermoacoustic energy conversion. In particular a multi-stage travelling wave thermoacoustic system is capable for direct converting medium temperature solar heat into cold. The process includes only two conversion steps, 1) from heat into acoustic power and 2) acoustic power into cold. In addition such a system lacks any mechanical moving parts in the process, except for the optional circulation pumps.

Since the start of thermoacoustics in the eighties of last century onset and operating temperatures of thermoacoustic engines is drastically lowered enabling for the use of vacuum tube solar collectors (VTSC) as input heat source for SOlar ThermoAcoustic Cooling (SOTAC) systems .

In order to test the SOTAC concept we have build a stand-alone sea container size cooler driven by a multi-stage travelling wave thermoacoustic system. On the roof of the container 9 m^2 VTSC are installed which should be sufficient to generate about 1.5kW of cooling power at a temperature of 8°C with an outdoor temperature of 30°C. The container is divided inside in two spaces; one accommodating the thermoacoustic system and one for cold storage. The "technical room" is depicted in Figure 1.

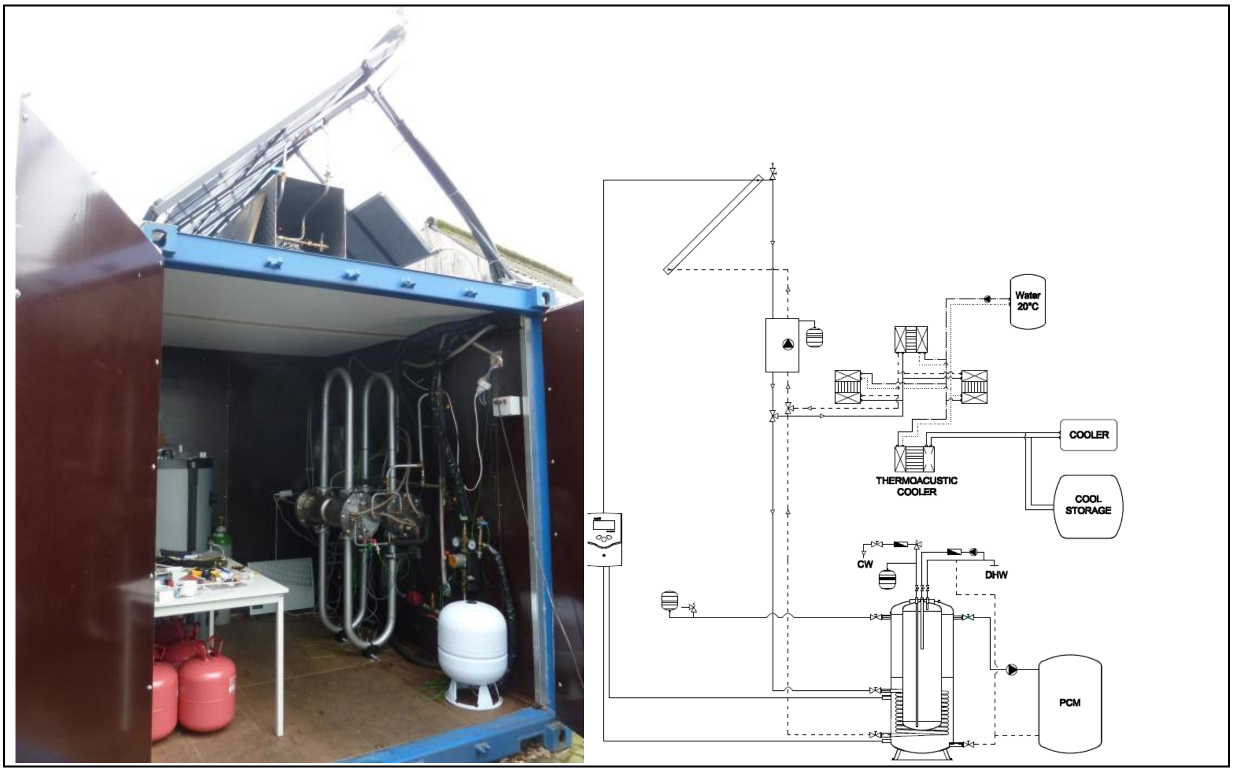

Figure 1: *Picture of the thermoacoustic cooling installation and scheme of the installation.*

While the thermoacoustic process is well understood and described, emphasis in this project is on the periphery. In particular the high temperature circuit connecting the VTSC's with the heat exchangers inside the thermoacoustic system turned out to be critical in design, because heat losses and heat transfer directly affect the overall system performance while safety aspects has to be considered as well.

Beside this also dimensioning and implementation of the heat rejection circuit to ambient and cold circuit to the cooling space affect the overall system performance.

The paper and presentation will address the theoretical and practical aspect of the design and build of a solar powered cooling system including periphery and support equipment together with the results from the test runs performed late summer.