HSLU Hochschule Luzern

Technik & Architektur
Master of Science in Engineering

Master-Thesis Mechatronics & Automation

Mechatronic Interface for Distribution of Fluid from One Input to Multiple Outputs

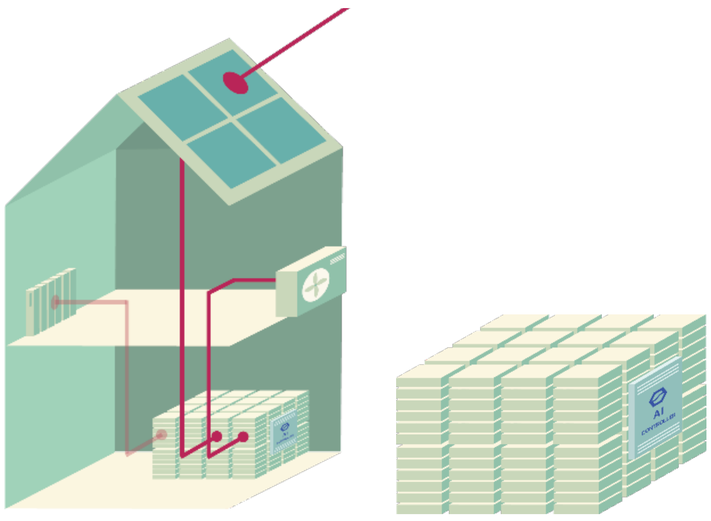

Fig 1: SeasonCell storage concept

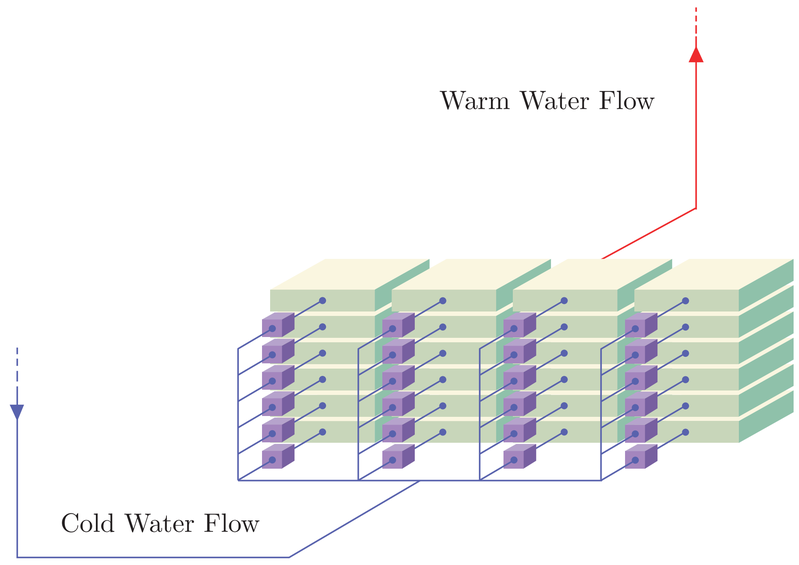

Fig 2: Conventional Solution

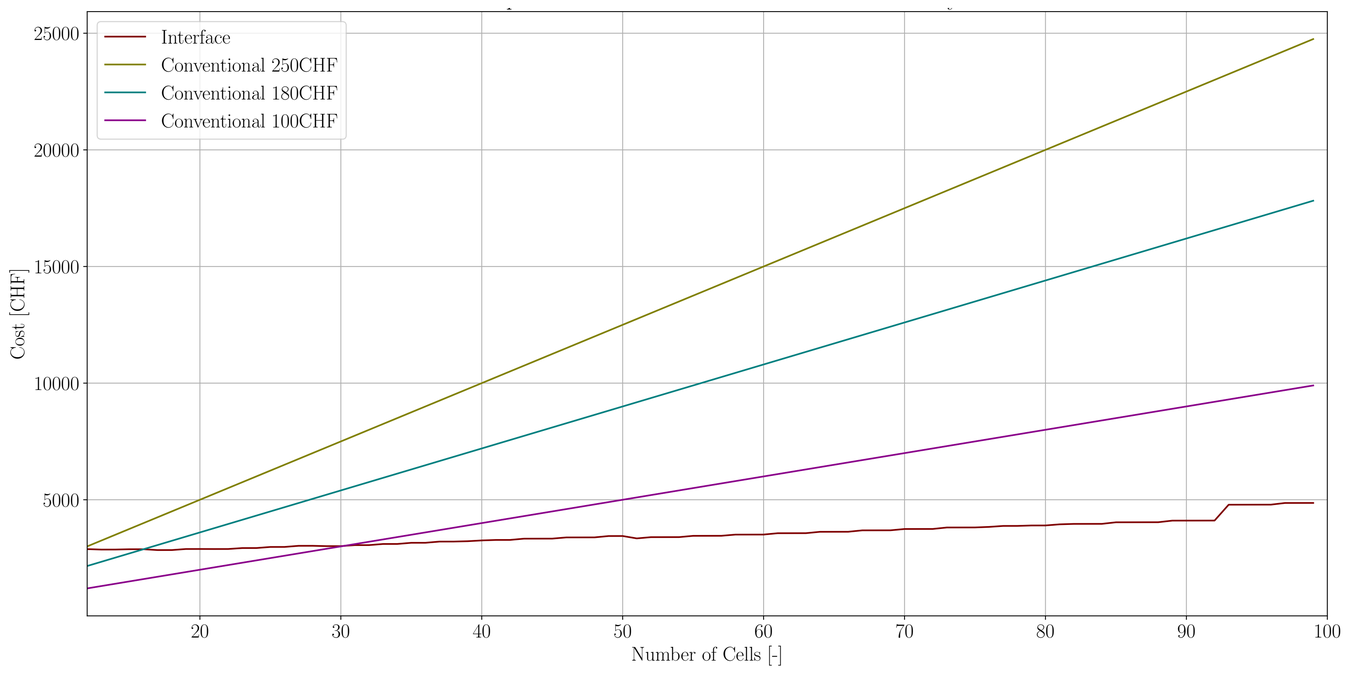

Fig 3: Cost Comparison Between Concept and Conventional System

Introduction

The ever-increasing demand for efficient and cost-effective energy storage solutions has driven innovative approaches in research and development in recent years. In this context, SeasonCell's project SC01 (Fig 1) emerges as a pioneering initiative in the field of thermal energy storage. The primary objective of this project is to design a novel heat storage system based on a two-dimensional grid of cells filled with Phase Change Material (PCM). Each of these cells should have the capability to be individually traversed by water, enabling targeted heat transfer.

However, the challenge lies in the intricate task of integrating this heat storage system into a heating circuit that ensures effective utilization of the stored heat. The specific challenge is to devise a method that allows the selective opening of individual cells while keeping all others closed. A conventional solution would be the use of individual open/close valves in front of each cell (Fig 2). Yet, as the number of cells increases, this approach becomes not only economically burdensome but also spatially impractical.

The present research is thus directed towards developing an innovative concept that not only addresses the cost efficiency of the system but also tackles the spatial challenge of accommodating an increasing number of cells. This involves exploring alternatives to the conventional valve-based solutions, seeking a method that permits the selective activation of specific cells without compromising the integrity of the entire heating circuit.

Procedure

The initial step involved investigating whether any existing solutions were available for the specific problem. It was soon apparent that no such solutions existed and that all industrial systems were using the conventional approach. The research then led to the creation of several concept sketches, which were summarised in a final concept. The concept was developed to provide a solution for heat storage systems of all sizes. A manual was created to guide the design of this concept. However, due to patent reasons, it is not possible to provide a description of the concept.

Results

The concept was applied to a test scenario, demonstrating that the manual created could provide a solution. This concept was further developed and manufactured as a mechatronic system. The components were finalised and then tested to ensure their accuracy. It has been demonstrated that the developed concept is more efficient and compact than the conventional solution that uses open/close valves, even with as few as 12 connections (Fig 3).

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