Open-cell metal foam latent heat storage systems for thermal management of fast responding systems

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Broker Company Name: Verhaert
Broker Name: Sam Waes
Telephone: +32 (0)3 250 19 00
Email: Sam.Waes@verhaert.com

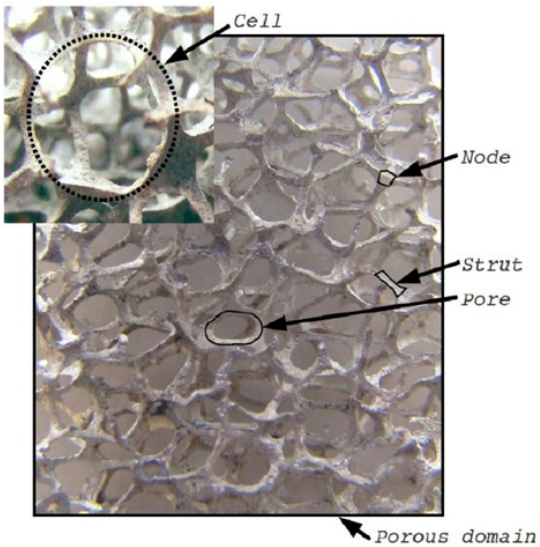
Abstract:

Phase change materials (PCM) are frequently used in thermal management solutions for temporary storage of heat or cold. Fast responding systems require fast loading and/or unloading thermal storage devices. This, however, cannot be achieved by using pure PCMs due to low thermal conductivity of the materials. In this technology offer open-cell metal foam is submerged in the PCM enhancing the response time up to a factor of 30. This breakthrough technology opens opportunities for fast-charging, compact, light-weight and cost-effective solutions.

Description:

The company provides thermal management solutions and engineering expertise with open-cell metal foam enhanced phase change materials, from initial idea to final product.

Metal foams are cellular materials, which form a class of porous media. The company works with open-cell metal foams and focusses on thermal aspects. Open-cell foams consist of a finite number of non-overlapping voids, interconnected via pores which allowa fluid (i.e. a gas or a liquid) to flow through the porous material. Various types of metal could be envisaged but currently most used is aluminum.



Open-cell metal foam shows many other interesting characteristics for thermal applications:

- High thermal performance, due to its large interstitial surface area between the aluminum and the fluid, up to 2500m²/m³, sharp struts which prevent the formation of thick boundary layers and excellent fluid mixing due to the complex flow paths through the metal foam.
- A high porosity, which makes it a very lightweight material, typically more than 90% of the foam volume is occupied by the fluid phase.
- Its stochastic nature ensures independency of the orientation of the incoming fluid flow, high flexibility in shaping complex geometries in 3D and creates a natural anti-fouling functionality.
- Mechanical robustness allows for integration with bearing structures and makes the application easily cleanable.
- Its organic shape makes it elegant and visually appealing.

Applications of metal foam can be found in heat exchangers, energy absorbers, chemical process enablers, vaporizers etc

The company solves thermal problems for industrial manufacturers. It offers proprietary simulation tools to simulate the thermo-hydraulic behavior of metal foam applications, design and engineering capacity for solution development as well as small quantities of metal foam for prototyping purposes. Currently they are looking into new applications.

Innovations and advantages of the offer:

- Create innovative products using fast responding latent heat storage solutions.
- Save on energy and cost by downsizing (or even eliminating) heating and cooling equipment and reusing stored thermal energy at a later time.
- Overcome the time delay between heat/cold production and demand.
- Reduce the storage volume by using the latent heat of PCMs instead of sensible heat of fluids.
- Unique engineering and know-how of metal foam enhanced phase change materials and integration into your systems.

Application:

Thermal management of (power) electronics cooling

Transport applications (road, rail, air)

Build environment

Space Heritage:

1. Several experiments have been executed by various institutes to research the behaviour in space of foam properties like drainage, rupture events, foam density, pore diameters, etc.

The XRMON experiment, devoted to x-ray radiographic observation of directional solidification under microgravity, has researched the formation & solidification of metallic alloys in a microgravity environment.

2. Aluminum foam is used as the heat exchange media and chemical support matrix for the atmospheric CO^2 control system on the space shuttle and International Space Station.

Broker Comments:

Forming of metal open cell metal foam has been researched and applied in various institutes and space contexts. In an ESA space experiment "Development of Advanced Foams under Microgravity" the technology was evaluated and received an 'Outstanding' rating based on scientific merit, innovation, industrial interest and microgravity relevance.

Some commercial applications are already available; however looking at the promising technological advantages of the material the further development potential is large.