Advanced High-Durability Containment System for Aluminium-Based Thermal Energy Storage

Summary

Profile type	Company's country	POD reference
Technology request	**Spain**	**TRES20250709018**
Profile status	**Type of partnership**	**Targeted countries**
PUBLISHED	**Commercial agreement with technical assistance** **Research and development cooperation agreement**	**• World**
Contact Person	**Term of validity**	**Last update**
Enrico FRANZIN	**9 Jul 2025** **9 Jul 2026**	**9 Jul 2025**

General Information

Short summary

A Spanish SME (Small and Medium-sized Enterprise) specialized in renewable energy and decarbonisation solutions seeks advanced containment technology for a modular thermal energy storage system using aluminium as a Phase Change Material (PCM).

The required technology must withstand over 5000 thermal cycles between 500–650 °C, maintain structural integrity and reliability, and support scalable manufacturing for industrial applications. A research or technical cooperation agreement is sought.

Full description

1. The requesting Spanish SME, located in Salamanca and strongly focused on R&D, specializes in developing innovative technologies aimed at industrial decarbonisation through renewable energy integration. Currently, the company is developing a novel thermal energy storage (TES) solution leveraging aluminium as a Phase Change Material (PCM) due to its high latent heat, sustainability, and recyclability.
2. The TES system operates on a daily charging and discharging cycle, aligned with solar and wind energy generation patterns. It aims to store excess renewable electricity as thermal energy in molten aluminium and release heat on demand for industrial processes such as steam generation, process heating, or direct thermal input into industrial machinery.

3. The primary technical challenge is the containment vessel, which must reliably withstand more than 5000 cycles of daily thermal cycling between temperatures of 500–650 °C. Traditional containment systems, commonly used in foundries, typically degrade rapidly under continuous cyclic operation, leading to structural failure caused by thermal fatigue, mechanical stress, and chemical reactions between molten aluminium and container materials.
4. The SME seeks an innovative material solution or structural design specifically engineered for high durability and chemical compatibility with molten aluminium. Such a containment system must prevent material degradation, cracking, or deformation over extensive cyclic operation, ensuring a robust, long-term performance in industrial settings. The desired cooperation would involve joint R&D activities, laboratory testing, prototyping, and eventual scaling of the containment solution through technical collaboration or research cooperation.

Advantages and innovations

This technology request aims to surpass existing commercial solutions currently available in the thermal storage and metallurgy industries. Conventional crucibles and containment vessels lack the durability required for continuous thermal cycling at high operational temperatures and often suffer premature degradation. The requested innovative containment solution will offer:

- Exceptional thermal fatigue resistance, enabling extensive cycling (≥5000 cycles) without performance loss.
- Chemical inertness and stable interaction with molten aluminium, preventing contamination and structural weakening.
- Enhanced structural integrity under extreme thermal gradients and mechanical stresses.
- Compact and modular design tailored for versatile industrial integration.
- Cost-effective scalability through simplified manufacturing processes and materials selection.

Successfully addressing these criteria will significantly advance thermal storage technology, contributing directly to industrial decarbonisation and energy efficiency improvements.

Technical specification or expertise sought

The partner or technological solution sought must meet or exceed the following specifications:

- Operational temperature range: 500–650 °C, optimized specifically around aluminium's melting point (~566°C).
- Durability exceeding 5000 thermal cycles, guaranteeing no significant structural degradation, cracking, deformation, or chemical corrosion.
- Compact and modular design suited to industrial scale applications, facilitating easy installation and maintenance.
- Cost-efficient and scalable production processes that utilize economically viable materials.
- High thermal efficiency with target heat loss limited to less than 20% per 24-hour cycle.
- Compliance with relevant European industrial safety standards and material regulations.

Proposals addressing low-temperature (<300 °C) applications or those not specifically engineered for molten-metal environments will not be considered relevant.

Stage of development

Under development

Sustainable Development goals

- **Goal 11: Sustainable Cities and Communities**
- **Goal 9: Industry, Innovation and Infrastructure**
- **Goal 12: Responsible Consumption and Production**
- **Goal 7: Affordable and Clean Energy**
- **Goal 13: Climate Action**

IPR Status

Secret know-how

IPR Notes

Partner Sought

Expected role of the partner

The ideal partner should be a university, research institution, or industrial organization with profound expertise and proven experience in high-temperature material science, advanced ceramics, metallurgical containment technologies, or related fields. Specifically, expertise in refractory materials, composite structures, and materials engineering tailored for extreme environments involving molten metals is highly desirable.
The partner is expected to:

- Developing or identifying advanced materials or structural designs specifically resistant to thermal fatigue and chemical degradation when in contact with molten aluminium.
- Conducting rigorous experimental validations and laboratory testing to ensure the containment system can reliably withstand over 5000 thermal cycles without structural or chemical deterioration.
- Provide specialized technical insight into material selection and optimization strategies to enhance performance, reduce costs, and ensure scalability.
- Collaborate closely on prototyping efforts, translating laboratory-scale solutions to commercially viable industrial prototypes.
- Facilitate knowledge transfer, including training and technical documentation, to ensure effective integration, maintenance, and operation of the containment technology within industrial applications.

Type of partnership

Commercial agreement with technical assistance

Research and development cooperation agreement

Type and size of the partner

- **R&D Institution**
- **University**
- **Other**
- **SME 11-49**
- **SME <=10**
- **SME 50 - 249**
- **Big company**

Dissemination

Technology keywords

- **02007022 - Conductive materials**
- **04001003 - Storage of electricity, batteries**
- **04005005 - Solar/Thermal energy**

Market keywords

- **06003001 - Solar/thermal energy**
- **06008 - Energy Storage**
- **03002 - Batteries**
- **06010003 - Energy for Industry**

Targeted countries

- **World**

Sector groups involved