

LININGS FOR PRESSURE VESSELS

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Temperatures cycling to 160 C (320 F) severely limit the variety of generic lining systems that can provide corrosion protection to a vessel substrate. Many of the conventional liquid-applied cross-linked epoxy systems will not perform at temperatures over 121 C (250 F). The options to consider include fluoropolymers, glass, brick, ceramic, and membrane systems.

Fluoropolymers are commonly used for high-temperature application. Several varieties of fluoropolymers exist, so it is important to use those that are suitable for the required service temperatures. Suitable coatings consist of highly fluorinated materials such as fluorinated ethylene propylene (FEP), perfluoromethylvinylether (MFA), perfluoroalkoxytetrafluoroethylene (PFA), or polytetrafluoroethylene (PTFE). The coatings are typically applied by spraying and baking multiple coats to the necessary thickness, or installing them in a welded sheet form. The adhesive bonding mechanism must be considered in selecting a sheet lining because most commonly used adhesives breakdown over 121 C (250 F). However, a recent development in fluoropolymer plasma treatments now allows high-temperature acrylics and silicones to be covalently bonded to fluoropolymer sheets.¹ This now makes it possible to install welded sheet systems for service temperatures to 246 C (475 F).

Ceramics and glass linings are also commonly used in high-temperature applications. These are specialised systems with unique characteristics that make them ideal for many applications. Lining and vessel manufacturers should be consulted to better

understand special design considerations, service potentials, and limitations.

Another common technology involves the use of a layer of brick or tile that is grouted in place with a temperature-resistant grout. The objective is to reduce the temperature over the brick or tiles to thermally insulate and protect an underlying membrane. There are many mem-

berial, the nature of the thermal cycling (rate of temperature increase or decrease), chemicals being stored or processed, permeability, and physical demands (abrasion, impact, etc.).

1. Garner Holdsworth, "Plasma Advancement Expands Applications of Fluoropolymer Coatings and Linings," *Materials Performance*, September 2001: 32.



What kinds of linings can be used to protect pressure vessels subject to a daily temperature cycle that reaches 160 C (320 F) and remains there for about half an hour?

brane materials, including rubber, asphaltic-based materials, organic coatings, fibreglass-reinforced vinyl esters, polyesters, or epoxies. It is not uncommon to install a fluoropolymer film (5–30 mils) behind the brick to provide an additional thermal and chemical resistance barrier to protect the substrate or membrane.

Some vessels are lined with alloy metal sheets to provide protection. Because this generic technology falls outside the scope of the coatings and linings industry, it is only referred to as another avenue the questioner may want to pursue. The potential of metal sheet linings merits mentioning.

When considering high-temperature applications, it is critical that the user or specifier consult with specialists and manufacturers to avoid premature or catastrophic failures at elevated temperatures and pressurised operating conditions. All of the solutions and systems have specific limitations that may be associated with the thermal gradients across the ma-

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Severe process requirements such as high temperature, pressure, and acidic exposures characterise many chemical processes, such as ore dressing or mineral purification. Flash vessels, in which the process liquids are "flashed" off, are used to cool and to depressurise the mother liquor, often with the help of saturated steam. Leach vessels operate similarly, but usually face less extreme conditions.

Almost every case includes short-term temperature cycles such as the one described in the question. A well-chosen combined acid-proof lining (CAPL) based on brick lining and a rubber layer can provide the necessary protection in these harsh conditions.

Boundary conditions are known for chemical engineering processes. In ore dressing, the condition could be a line consisting of several cascaded flash

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