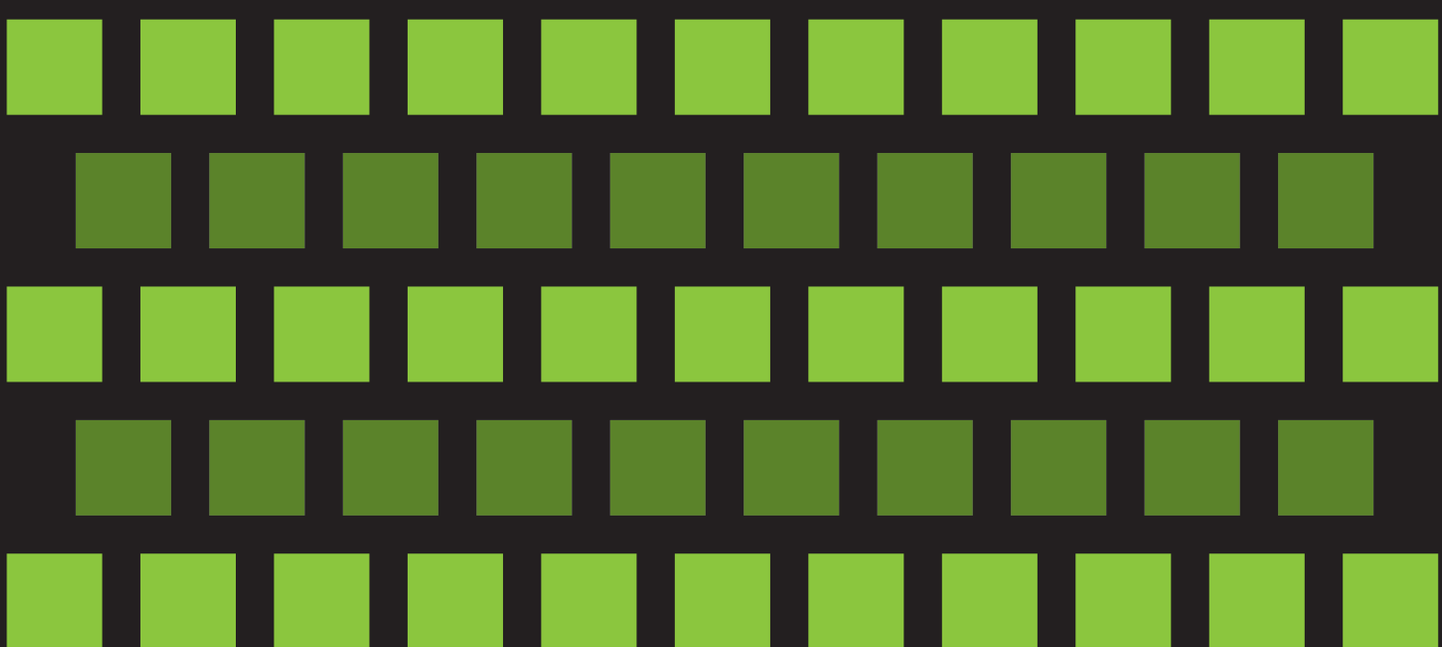
STP/PT-004

IMPREGNATED GRAPHITE FOR PRESSURE VESSELS



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FOREWORD

This Standards Technology Publication is the result of a development project sponsored by ASME Pressure Technology Codes and Standards and performed under the oversight of the Special Working Group on Graphite Pressure Equipment, and the ASME Standards Technology, LLC.

Established in 1880, the American Society of Mechanical Engineers (ASME) is a 120,000 member professional not-for-profit organization focused on technical, educational and research issues of the engineering and technology community. ASME conducts one of the world's largest technical publishing operations, holds numerous technical conferences worldwide, and offers hundreds of professional development courses each year. ASME maintains and distributes 600 Codes and Standards used around the world for the design, manufacturing, and installation of mechanical devices. Visit www.asme.org for more information.

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ABSTRACT

Impregnated graphite (also called impervious graphite) is a material that has been in industrial use for the past 60 - 70 years. The primary industrial use has been in the construction of chemical processing equipment where the exceptional corrosion resistance and high thermal conductivity of graphite is particularly advantageous. Typical applications include the manufacture of pharmaceuticals and phosphate fertilizer, steel pickling, processing of chlorinated organics, flue gas treatment, HCl and H_2SO_4 production and recovery, plus the manufacture of chemical intermediates.

The impervious graphite used for the construction of graphite pressure vessels is a composite material, consisting of "raw" graphite that is impregnated with a resin using a tightly controlled pressure/heat cycle. The interaction between the raw material and the resin is the determining factor when considering the design characteristics of the material. The design characteristics include the strengths (flexural, compressive, tensile), porosity, coefficient of thermal expansion, thermal conductivity, and ultimately the safe operating life of the vessel.

Proposed new pressure vessel rules will apply to the impregnated material only. There are two main reasons for this. First, the raw material is porous in nature and cannot be used as a pressure-containing material. Second, the resin impregnation process is a major factor when considering the properties of impregnated graphite. To consistently meet the minimum design values, the resin impregnation process must be tightly controlled. The resin impregnation processes used today have been developed over a 70-year period. The essential variables of the process have been defined and apply universally to all manufactures of impervious graphite equipment. By verifying the essential variables, it is possible to assign a lot number to all certified materials. The manufacturer's control of this process is assured through meaningful and consistent test data. The long and successful worldwide experience with impregnated graphite vessels demonstrates that impregnated graphite vessels are safe and reliable under various aggressive service conditions.

This report presents a view of current best practices and recommendations for development of new rules. This paper describes many of these rules and much of the logic that has gone into creating the proposed section, and it is intended to provide a basis for the development of consensus standards addressing the use of impregnated graphite for ASME Section VIII Division 1 pressure vessels. It is the hope of the committee that this document will help to provide a strong background of information supporting continued efforts directed at inclusion of the proposed part UIG in Section VIII.