IMPROVEMENTS IN FEA OF COMPOSITE OVERWRAPPED PRESSURE VESSELS

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ABSTRACT

Finite element analysis (FEA) of a composite overwrapped pressure vessel (COPV) has traditionally been a tedious and time consuming task. FEA is often omitted in the development of many vessels in favor of a "build and burst" philosophy based only on preliminary design with netting analysis. This is particularly true for small vessels or vessels that are not weight critical. The primary difficulty in FEA of a COPV is the creation of the model geometry on the sub-ply level. This paper discusses employing a commercially available tool to drastically reduce the time required to build a COPV FEA model. This method produces higher fidelity models in only slightly more time. Analysis results are presented along with comparisons to burst test data. Additionally the application that inspired this tool's development is discussed.

1. INTRODUCTION

COPV's have been in use for decades and are currently used in a variety of applications from giant solid rocket motor cases to tiny paint-ball gun pressure reservoirs. They are found most frequently in applications where component weight is critical. In these applications, COPV's have obvious advantages over homogenous metallic pressure vessels.

This paper offers background on some of the issues involved with COPV design and analysis. It then compares traditional COPV design and analysis (netting analysis & manual FEA) to COPV design and analysis employing an automated FEA tool known as the Wound Composite Modeler (WCM) for ABAQUS. It also presents the results of a COPV design for a high pressure gas storage vessel using WCM. The target audience for this paper is individuals who are generally familiar with COPV design, analysis and fabrication. Not all terms, theories, techniques and methods are fully explained. More complete explanations are available in the references.