

Keywords: composite material, dielectric properties, defects

Introduction

There is a great interest in the oil industry for a multiphase flow meter enabling the replacement of separators on offshore topside facilities. The NMR(nuclear magnetic resonance) technique has the potential to distinguish the separate components in crude oil at the well. The constraints for the use of an NMR in this conditions implies the use of glass-fibres reinforced composite materials for their non-magnetic and dielectric properties.

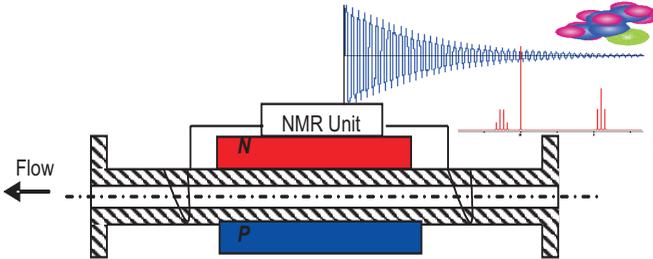


Figure 1. Principle of NMR Multiphase flowmeter

Scope

The UT concentrates on the material research of a tube with integrated flanges. An optimum is searched for fiber orientation, stiffness and strength of the structure, and, inversely, prediction of the process parameters to achieve optimum performance. A prototype will be delivered.

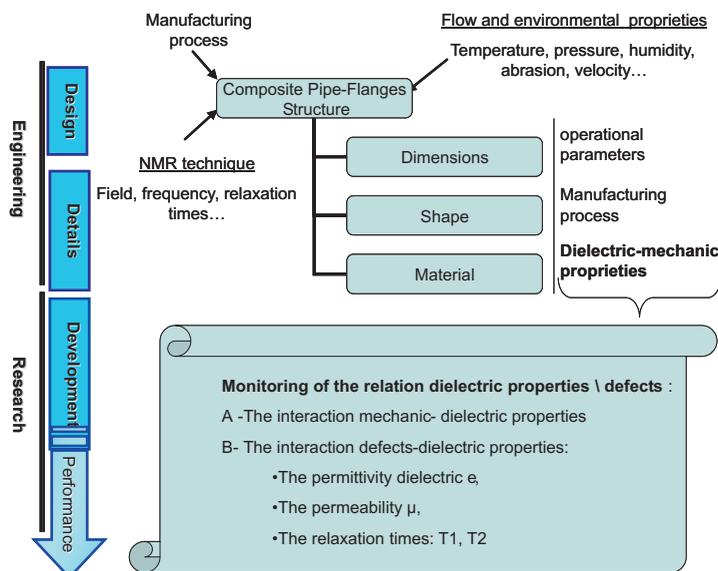


Figure 2. Material research and methodology

One of the key issues is the influence of the defects (process-induced) in the composite structure on its dielectric properties. A thorough understanding of the physics is necessary.

Modeling

A model is developed to describe the relation structure - dielectric properties.

This model is based on:

- Maxwell-equations in heterogeneous material,
- Gauss-equations: continuity of the electric potential and its derives on the interface fiber-matrix.

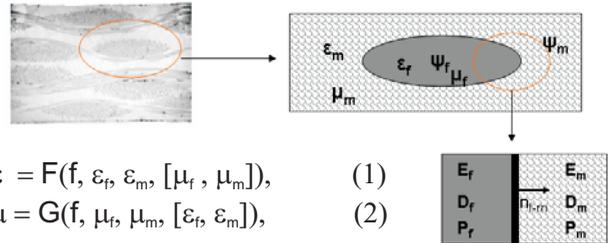


Figure 3. From actual cross-section to math.model

Experimental work

Experiments were performed with different structures and defects. In a first set-up, we consider the specimen of composite material as a capacitor and a resistance in parallel, and measure the impedance in order to derive the permittivity.

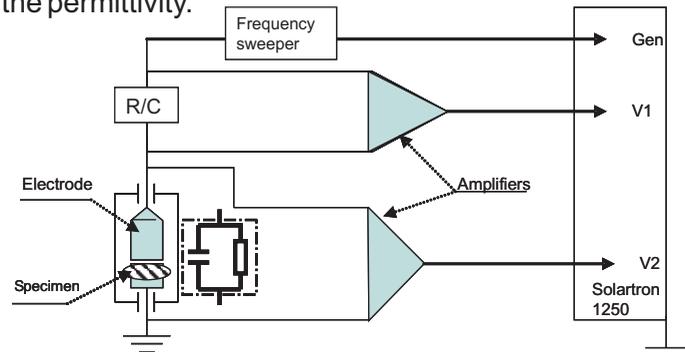


Figure 4. Principle of impedance measurement

Preliminary results show that the structure of the composite and the presence of micro-defects affect significantly the dielectric properties of the composite.

Conclusion

It was shown that defects in composite materials can be identified by measuring the dielectric properties. A model will be developed to determine the influence of defects on the performance of the NMR.

Reference

Krohne - EET project 11th tender: Replacement of offshore separators by NMR multiphase flowmeter tech.