



Dielectric Properties of Oil Sands at 2.45 GHz with TE_{1,0,11} Mode Determined by a Rectangular Cavity Resonator

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ABSTRACT

Oil obtained from oil sands resources constitute an important portion of the oil industry in Canada. Extraction of the bitumen from oil sands is very crucial process because of its cost and environmental impact. Microwave energy applicators by heating oil sands at microwave frequencies can be an excellent alternative to extract bitumen with the advantages of being potentially cost-effective and environmentally friendly method of extraction. In order to design and manufacture a microwave energy applicator, its dielectric properties must be known. In this study, as the first part of our ultimate microwave energy applicator project, in advance, the complex permittivity of oil sands was measured by using rectangular cavity resonator, designed and fabricated in École Polytechnique de Montréal laboratories, at 2.45 GHz with TE_{1,0,11} mode. The accuracy of the permittivity measurement results obtained with the developed system was verified against those obtained using a commercial open-ended probe system as well the values of well known materials documented in open literature. Since there is no study found in the literature about the complex permittivity values of oil sands at 2.45 GHz, the present study would be of great help and important guide for those who plan to design and manufacture microwave energy applicators in order to extract the bitumen from the oil sands.

KEYWORDS: Dielectric properties, Complex permittivity, Dielectric constant, Loss factor, Cavity resonator, Oil sands

INTRODUCTION

Oil sands are the aggregate matrix of sand and clay containing bitumen and water called as tar sands or bituminous sands as shown in Figure 1. It can contain large amounts of sulphur and oil components [Government of Alberta, Alberta's Oil Sands, March 2008; Simon Dyer, "Environmental impacts of oils sands development in Alberta," The Oil Drum, September 2009].