Hydrocarbon management

HM 1901

Volume correction by velocity of sound

energy institute

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VOLUME CORRECTION BY VELOCITY OF SOUND

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1 BACKGROUND AND INTRODUCTION

The current Institute of Petroleum (IP)/American Society for Testing and Materials (ASTM)/ American Petroleum Institute (API) tables present several algorithms for correcting ambient measurements to standard conditions for trade accounting and loss control purposes. The algorithm selected depends on the nature of the hydrocarbon concerned. Many hydrocarbons do not 'fit' any of the algorithms very well, and several key producing countries use alternative tables or algorithms.

Previous Energy Institute (EI)-led investigations* from measurements made on over 200 samples of crude oil and products found that by introducing a velocity of sound (VoS) term into an equation to predict expansivity, errors in density-temperature predictions could be significantly reduced.

A subsequent review of the original data showed that the relationship between VoS and density is considerably closer than originally indicated. It seemed likely that a single determination of density, temperature and VoS for any hydrocarbon liquid would enable density at other temperatures to be predicted using a single simple algorithm, and with greater accuracy than using one or other of the existing algorithms. This would provide for more accurate accounting and better loss control.

The project was divided into three stages:

a) Development/confirmation of the VoS/density/temperature relationship working from the original data.

b) Further confirmation of the relationship in a) from new determinations of density and VoS using existing and additional samples including 'new' products (e.g. fatty acid methyl ester (FAME) and methanol blended fuels). This work to use improved instrumentation.

c) Laboratory evaluation of the performance of commercially available ultrasonic meters and ultrasonic insertion probes to provide VoS measurements for use in volume correction calculations.

Each stage dependent on the success of the previous one.

Stage a) is carried out by the National Physical Laboratory (NPL). This is complete, appears successful and is presented here.

Stage b) and c) were not started due to the preferred laboratory ceasing to be available.

The EI provided project management services through Melverley Consultants Limited.

The raw data and calculation spreadsheet developed under stage a) – Microsoft Excel files – are archived at the Energy Institute, 61, New Cavendish Street, London. W1G 7AR.

* EI (then IP) report: *Volume correction factors by velocity of sound*, December 2003