Data Article

Magneto-rheological dataset for an extra heavy crude oil (8.5°API) in the presence of a constant magnetic field

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**Abstract**

The dataset in this article includes magneto-rheological parameters of an extra heavy Colombian crude oil (8.5°API) in the presence of a static magnetic field. Considering the availability of this type of data is limited, the parameter values for Shear Rate, Shear Stress, Viscosity, Rotational Speed, Torque and Viscosity for three temperatures, i.e., 30, 50 and 70 °C, are hereby included in detail. The shear rate was systematically varied from 1 to 100 [s\(^{-1}\)]. In the same way, another data set was obtained by applying a magnetic field of 0.17, 0.35 and 0.65 T (this parameter is also known as magnetic flux density or magnetic induction, in Teslas [T]). Enough experimental data for each temperature, were gathered, to generate the magneto-rheological curves for the extra heavy crude oil samples, with and without the presence of a static magnetic field.

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1. Data

Magneto-rheology is an area of active research, mainly in the field of materials, recovery, and transportation of hydrocarbons, [2–5]. The dataset included in this article contains experimental results showing the effect of a static magnetic field on the viscosity of several samples of an extra heavy Colombian crude oil. It is necessary to note that no magnetic material was added to the crude samples.

In this section, we report information related to the variation of the viscosity due to the effect of temperature changes, sequential variation of the shear rate and exact fine-tuning of an external static magnetic field. Fig. 1 shows the simultaneous effect of the temperature and shear rate variation on the viscosity of an extra heavy crude oil sample. In this case, the temperatures were 30, 50 and 70 °C, respectively, while the shear rate changed from 1 to 100 s⁻¹.

Fig. 2 shows the effect of temperature, shear rate and the external static magnetic field on a sample viscosity, but at 30 °C, adjusting the external magnetic field to 0.17, 0.35 and 0.65 T, respectively.

Fig. 3 includes the variation of the viscosity of a crude oil sample, but this time, at T = 50 °C. The external magnetic field values were preserved, and the shear rate changed from 1 to 100 s⁻¹.

Finally, Fig. 4 describes the variation of the viscosity due to the effect of the external magnetic field and the shear rate, but in this case, at T = 70 °C. Other forms of representation can be made from the raw data for all the experiments carried out. The dataset includes 12 tables (12,000 rows, 7200 measurements) and 4 figures.
Fig. 1. Rheological data of an extra heavy crude oil at 30 °C (303.15 K), 50 °C (323.15 K) and 70 °C (343.15 K), 1–100 s⁻¹.

Fig. 2. Magneto-Rheological data of an extra heavy crude oil at 30 °C (303.15 K) in the presence of a magnetic field of 0.17 T, 0.35 T and 0.65 T, respectively.
2. Experimental design, materials, and methods

The dataset includes in detail the values of the magneto-rheological parameters which are described as follows: Shear Rate \([\text{s}^{-1}]\); Shear Stress \([\text{Pa}]\); Viscosity \([\text{Pa} \cdot \text{s}]\); Rotational Speed \([\text{min}^{-1}]\); Torque \([\mu\text{Nm}]\) and Viscosity \([\text{Cp}]\). The viscosity data were acquired using an Anton Paar Rheometer MCR 302 with an online measurement of magnetic flux density. The heavy crude sample was placed in the viscometer using the cone-plate geometry. The experiments were carried out at three temperatures: 30 °C (303.15 K), 50 °C (323.15 K) and 70 °C (343.15 K). The shear rate was increased and controlled from 1 to 100 \([\text{s}^{-1}]\). In the same way, another set of experimental data was obtained, applying a static magnetic field (also known in the technical literature as magnetic flux density or magnetic induction in Teslas \([\text{T}]\)) of 0.17, 0.35, 0.65 T to extra heavy crude samples. The same experimental methodology was applied for all the crude oil samples. The samples were kept in an oven at room temperature at least 24 hours before the experiments. Each sample was randomly selected. No experiment duplication was allowed using the same sample. After each one of the experiments was completed, the data was automatically saved by the rheometer. From the experimental data, it was possible to generate the rheological curve of the oil crude with and without the presence of a static magnetic field. Data tables are included. Figs. 1–4 compiled a series of experiments at certain temperature conditions, a range of shear rates and the presence or not of a magnetic field.
Fig. 4. Magneto-Rheological data an extra heavy crude oil at 70 °C (343.15 K) in the presence of a magnetic field of 0.17 T, 0.35 T and 0.65 T, respectively.

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Transparency document

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.103902.

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