

Rheo-microscopy in situ synchronous measurement

The rheological measurement of the experimental oil samples was carried out by Anton Paar's MCR-702 dual drive rheometer instrument, MCR 702 dual drive modular rheometer is a parallel round plate, rheometer see Fig.1(a), It is equipped with an in-situ microscopic observation module, which can simultaneously observe the macroscopic rheology and microstructure changes of crude oil samples. The structure of this experimental system is shown in Fig.1(b). The experimental instrument adopts 43mm parallel plate measurement system, the measuring rotor (upper plate) and the stage (lower plate) are made of transparent quartz glass for easy microscopic observation, the measurement gap is adjustable. The best rheological measurements and microscopic observations can be obtained after experimental trials, equipped with a 2/3 inch CCD camera from Lumenera Canada with a field of view of $440\mu\text{m} \times 330\mu\text{m}$. Due to the poor light transmission of waxy crude oil itself, in order to improve the observation quality, an additional light source is added to the upper part of the sample to irradiate the sample, so that it and the instrument supporting light source together to form a multi-angle composite light source. By combining reflected and projected light, polarized light and natural light, better microphotography quality can be obtained. Although the measurement system directly obtains two-dimensional microscopic images, the dynamic motion behavior and arrangement structure changes of wax crystals and water droplets in three-dimensional space can be identified through the shooting and sequence image processing of the video of the wax crystals and their water droplets movements, and the structural and morphological evolution of the wax crystals and water droplets in the shear flow field can also be identified in situ.



(a) MCR 702 dual drive modular rheometer

(b) Schematic diagram of experimental device

Fig.1 The rheo-microscopy in situ synchronous measurement system