भारतीय मानक **IS 18877 (Part 4) : 2024**

Indian Standard

सीबीएम मूल्यांकन के लिए प्रयोगशाला उपकरण — रीति संहिता

भाग 4 घूर्णी विस्कोमीटर

Lab Instruments for CBM Evaluation — Code of Practice

Part 4 Rotational Viscometer

ICS 73.020

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भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

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FOREWORD

This Indian Standard (Part 4) was adopted by the Bureau of Indian Standards, after the draft finalized by the Method and Equipments for Underground Coal Gasification and Coal Bed Methane Sectional Committee had been approved by the Mechanical Engineering Divisional Council.

Coal bed methane is the form of natural gas that is adsorbed into the solid matrix of coal. It is different from the conventional gas reservoirs as the methane is stored within the coal seams through the process of adsorption. The natural fractures in the coal seams (known as cleats) are responsible for the flow behaviour and provide the major channels for gas flow.

Several laboratory studies are carried out for CBM exploration/extraction as well as at the time of CBM operations. The laboratory studies include with various geological and geochemical data collection, data analysis, quality check and quality control of operation fluid while drilling, hydro-fracturing etc. The lab studies are essential to evaluate the gas reserve as well as for strategy finalization for exploration methodologies. One of the most challenging tasks in CBM evaluation are effluent (produced water) handling.

Assistance has been drawn from ISO 13500 : 2008 ‘Petroleum and natural gas industries — Drilling fluid materials — Specifications and tests’, issued by International Standards organization and ISO 10414-1 : 2008 ‘Petroleum and natural gas industries — Field testing of drilling fluids — Part 1: Water-based fluids’, issued by International Standards organization while preparing this Indian Standard.

The code of practices for lab instruments for CBM evaluation is in four parts. This standard (Part 4) covers the rotational viscometer. Other parts in this series under the general title are as follows:

Part 1 Mud balance

Part 2 Marsh funnel and graduated cup

Part 3 Turbidity meter

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a. test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded-off value should be the same as that of the specified value in this standard.

Indian Standard

LAB INSTRUMENTS FOR CBM EVALUATION — CODE OF PRACTICE

PART 4 ROTATIONAL VISCOMETER

1 SCOPE

The rotational viscometer is a universal and multifaceted instrument for quality analysis and measurement of various rheological property of drilling fluid/hydro-fracturing fluid. It measures the flow characteristics of fluid in terms of shear stress and shear rate over various time and temperature ranges at atmospheric pressure.

2 ROTATIONAL VISCOMETER

The rotational viscometer the type of coaxial cylinder rotational viscometer (coutte). It is the type of direct indicating viscometer powered by an electrical motor. The measuring fluid is accommodated between the two cylinder (rotor and bob). While rotation of the outer cylinder (rotor) it pulls the nearby fluids and as a consequence it transfers the force to the inner coaxial cylinder (bob). The torque generated to the bob and the torsion spring at the top of bob leads to the deflection. The device simulates to the various flow characteristics in terms of test conditions and constant factors.

2.1 Design and Requirement

2.1.1 *General Features*

a) The rotational viscometer should be complete in all respects and should work on six speeds or twelve speeds for measuring oil field fluids properties at different shear rates;

b) It should be complete with rotor, bob, sleeve, torsion spring assemblies, and stainless steel sample cup and reduction gear assembly; and

c) The equipment should operate at 230 V a.c., a suitable power converter should be supplied with the equipment to convert from 230 volts a.c.to 115 volts a.c.

2.1.2 *Environmental Conditions*

a) Ambient temperature — 0 °C to 50 °C or as per the requirement; and

b) Relative humidity — Up to 95 percent without condensation or as per the requirement.

2.1.3 *Technical Features*

The main components of the instrument and technical features are as under:

a) Rotor sleeve — R1

Inside diameter	36.83 mm (1.450 inch)
Total length	87.0 mm (3.425 inch)
Scribed line	58.4 mm (2.30 inch) above the bottom of sleeve, with two rows of 3.18 mm
(0.125) holes, spaced 120° (2.09 rad) apart, around rotor sleeve just below scribed line. Sleeve surface	surface roughness average 16 to 32 cross-hatch honed;

b) Bob — B1, closed with flat base and tapered top

Diameter	34.49 mm (1.358 inch)
Cylinder length	38.0 mm (1.496 inch)
Rotor surface	surface roughness average 16 to 32 cross-hatch honed;

c) Torsion spring constant — F1.0

Torsional stiffness	10.54 Nm/rad (386 dyne-cm/degree deflection)
Shear stress constant	29.3 Pascal per radian deflection (0.511 Pascal per degree of deflection) (1.065 lb/100 ft2 and degree of deflection);

d) Sample cup — Cylindrical cup of 3" (inch) outer diameter, 500 ml capacity with an inside mark at 350 ml level. It should be

made of stainless steel (316SS) suitable for handling fluids in *p*H range of 7 to 14;

e) Read out — Digital or analog;

f) Shear stress range — 0 dynesto 1500 dynes per centimetre square(min);

g) Test speed — 6/12 test speeds selectable for viscometer in 1 to 600 rpm range. Test speeds of 3 rpm, 6 rpm,100 rpm, 200 rpm, 300 rpm and 600 rpm are must;

h) Calibration kit — The instrument should be with auto calibration system and with manual calibration kit and calibration fluid at the range temperature; and

j) Arrangements to fix up sample cup with the base plate.

3 CALIBRATION

The instrument will be regularly maintained and calibrated to get accurate result as per the specification. The calibration procedure of rotational viscometer will be followed in accordance with manufacturer's recommended procedure with the calibration fluid. While calibration, manufacturer supplied calibration fluid and temperature chart will be used.

4 INSTALLATION AND TESTING

Installation and testing will be done as per the manufacturer recommended standard procedure. However, following common practices may be followed:

a) Before starting the equipment, make sure all the accessories (like bob, rotor sleeve) and moving parts are properly mounted;

b) Sample cup must be properly clamped to the viscometer stand;

c) Put through power supply (220 V/50 Hz) followed switch on the main switch to standby mode. Select the parameters of measurement (viscosity, shear stress etc);

d) Fill in the sample cup with fluid till the inner marking;

e) Sample cup can be easily adjusted using the movable clamp present on the viscometer;

f) To get accurate readings rotor sleeve should be immersed (till red marking on rotor sleeve) into the testing fluid;

g) Select the speed button as required. Push the start button for operation;

h) Before testing the sample, agitation of the fluid (if required) can be done for up to 2minto 3 min at 600 rpm;

j) Readings can be calculated at 600 rpm, 300 rpm, 200 rpm, 100 rpm, 6 rpm and 3 rpm to get the value of viscosity;

k) In order to measure the 10 s gel strength (at 3 rpm), allow the sample to remain in quiescent for 10 s. After 10 s turn the motor on to the low speed position and measure the maximum dial deflection before the gel breaks;

m) For 10 min gel strength, re-stir the sample at high speed (600 rpm) before allowing it to remain quiescent for 10 min. Repeat the gel measurement as before and report the maximum dial deflection as the 10 min gel strength; and

n) After performing the experiment, power cable should be properly removed.

5 DOCUMENTATION

a) Past track record of at least last two years for rotational viscometer supplied in oil industry that is purchase orders, inspection release notes, user feedback with their communication details etc shall be provided;

b) Manufacturer's data and descriptive literature for the equipment and materials of construction by ASTM reference and grade, coating(s) etc specifications;

c) Calibration and test report of manufacturer shall be furnished;

d) Installation and operation manual in English language shall be provided along with the supply; and

e) Warranty/Performance guarantee certificate shall be furnished.

ANNEX A

(*Normative*)

ROTATIONAL VISCOMETER-DATA SHEET

Sl No.	*Description*	*Details*
(1)	(2)	(3)
i)	Rotor sleeve size and dimension	-
ii)	Bob size and dimension	-
iii)	Torsional spring	-
iv)	Data sheet	-
v)	Read out	Digital or analog
vi)	Calibration kit	-
vii)	Shear stress range	0 dynesto 1500 dynes per centimeter square (min)
viii)	Test speed	3 rpm, 6 rpm,100 rpm, 200 rpm, 300 rpm and 600 rpm
ix)	Calibration fluid	20 CP, 50 CP, and 100 CP

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Method and Equipments for Underground Coal Gasification and Coal Bed Methane Sectional Committee, MED 37

Organization	*Representative*(*s*)
Oil and Natural Gas Corporation Limited, New Delhi	SHRI UDAY PASWAN **(*Chairperson*)**
Atlas Copco Construction and Mining Sales, Pune	SHRI ANIMESH NANDY
Bharat Heavy Electrical Limited, New Delhi	SHRI TIRUPATHI NAIDU CHINTALA
Bharat Heavy Electricals Limited, Project Engineering Management, Noida	SHRI RAJESH RANJAN SHRI SAUMEN KUMAR BHAUMIK (*Alternate* I) SHRI PRADEEP KUMAR SHARMA (*Alternate* II)
Central Electricity Authority, New Delhi	SHRI SUNIT GUPTA SHRI ASIF IQBAL DEPUTY (*Alternate*)
Central Mine Planning and Design Institute Limited, Ranchi	DR AKHILESH SINGH
CSIR - Central Institute for Mining and Fuel Research, Dhanbad	DR DEBADUTTA MOHANTY SHRI JAYWARDHAN KUMAR (*Alternate*)
CSIR - Central Mechanical Engineering Research Institute, Durgapur	DR MALAY KUMAR KARMAKAR (*Alternate*) DR CHANCHAL LOHA (*Alternate*)
Directorate General of Hydrocarbons, Noida	MS AARTI GUPTA SHRI TRILOK NATH (*Alternate*)
Directorate General of Mines Safety, Dhanbad	SHRI SAIFULLAH ANSARI SHRI A. RAJESHWAR RAO (*Alternate*)
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GAIL (India) Limited, New Delhi	SHRI RAJESH BAGARIA SHRI A. K. PORWAL (*Alternate*)
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Oil and Natural Gas Corporation Limited, New Delhi	SHRI A. K. PASWAN SHRI SHAKEEL AHMED (*Alternate*)
In Personal Capacity (*Flat No.* 3052, *Prestige Shantiniketa, Whitefield main road, Bengaluru*)	SHRI R. K. SHARMA
In Personal Capacity (*D-24, Amar Colony, New Delhi*)	SHRI RUDRA PRATAP SINGH

Organization	*Representative*(*s*)
BIS Directorate General	SHRI K. V. RAO, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (MECHANICAL ENGINEERING)[REPRESENTING GENERAL (*Ex-officio*)]

Member Secretary
SHRI AMAN DHANAWAT
SCIENTIST 'C'/DEPUTY DIRECTOR
(MECHANICAL ENGINEERING), BIS

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices: *Telephones*

Central : 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002 { 2323 7617

Eastern : 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091 { 2367 0012 2320 9474

Northern : Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019 { 265 9930

Southern : C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113 { 2254 1442 2254 1216

Western : 5th Floor/MTNL CETTM, Technology Street, Hiranandani Gardens, Powai, Mumbai 400076 { 2570 0030 2570 2715

Branches : AHMEDABAD, BENGALURU, BHOPAL, BHUBANESHWAR, CHANDIGARH, CHENNAI, COIMBATORE, DEHRADUN, DELHI, FARIDABAD, GHAZIABAD, GUWAHATI, HARYANA (CHANDIGARH), HUBLI, HYDERABAD, JAIPUR, JAMMU, JAMSHEDPUR, KOCHI, KOLKATA, LUCKNOW, MADURAI, MUMBAI, NAGPUR, NOIDA, PARWANOO, PATNA, PUNE, RAIPUR, RAJKOT, SURAT, VIJAYAWADA.

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