भारतीय मानक

IS 18997 : 2024

Indian Standard

प्रभावी उत्पादित जल प्रहस्तन और सीबीएम प्रचालनों में उपचार पद्धतियाँ और उपचारित जल की विशिष्टि — रीति संहिता

Effective Produced Water Handling and Treatment Methods in CBM Operations and Specification of Treated Water — Code of Practice

ICS 73.020

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

FOREWORD

This Indian Standard 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 Division 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) provide the major channels for gas flow. The capacity of the coal matrix to hold an amount of gas depends on the pressure at the constant temperature. The relationship between gas storage capacity and pressure at constant temperature is known as an isotherm.

CBM gas is produced from the coal reservoir by desorption technique. Methane is produced by depressurizing the coal that is by dewatering from the coal reservoir. The gas production from a particular coal reservoir will not start until production of water leads to reduction of reservoir pressure (critical desorption pressure). Initially single-phase flow of water dominates and with time as reservoir pressure reduces, desorption of gas starts with commencement of bubble flow. With time, gas rate starts dominating water production, reaches maxima and then gradually drops. In contrast to conventional gas production, the amount of water extracted declines proportionally with increasing CBM production. Huge volumes of groundwater are extracted from the production well to facilitate the production of CBM.

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

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

EFFECTIVE PRODUCED WATER HANDLING AND TREATMENT METHODS IN CBM OPERATIONS AND SPECIFICATION OF TREATED WATER — CODE OF PRACTICE

1 SCOPE

This standard covers the handling and treatment methods of water produced in CBM operations. CBM extraction includes generation of quantum amount of groundwater as a by-product. However, in CBM gas production, the primary concern is to knock out the plenty amount of water. Hence the handling, treatment and disposal of the produced water is a big concern for the organizations involved in CBM business. Therefore, periodically quality analysis and data monitoring of produced water is necessary. The *environment protection act* (EPA 1986) is followed for the handling and disposal of produced water.

2 SPECIFICATION OF TREATED WATER

The specification of treated water is considered in line with the disposal limit of treated effluent water to the inland surface water (river) as per the *Environment Protection Rule*, 1986 for the oil and gas drilling and processing facilities.

Specification of treated water is as follows:

Sl No.	*Parameter*	*Disposal Limit*
(1)	(2)	(3)
i)	*p*H	5.5 to 9.0
ii)	Temperature	40 °C
iii)	Suspended solids	100 mg/l
iv)	Total dissolved solids	2 100 mg/l
v)	Zinc	2 mg/l
vi)	BOD	30 mg/l
vii)	COD	100 mg/l
viii)	Chlorides	600 mg/l
ix)	Sulphates	1 000 mg/l
x)	Percent sodium	60 mg/l
xi)	Oil and grease	10 mg/l
xii)	Phenolic	1.2 mg/l
xiii)	Cyanides	0.2 mg/l
xiv)	Fluorides	1.5 mg/l
xv)	Sulphides	2.0 mg/l
xvi)	$Chromium^{6+}$	0.1 mg/l
xvii)	Chromium (total)	1.0 mg/l
xviii)	Copper	0.2 mg/l
xix)	Lead	0.1 mg/l
xx)	Mercury	0.01 mg/l
xxi)	Nickel	3.0 mg/l

3 HANDLING OF PRODUCED WATER

CBM gas is produced by dewatering of formation water from the well. In CBM well, water produced through tubing and gas is produced through annulus. The produced wet gas is initially passed through a separator for gravitational separation of water-gas mixture. The separated gas is diverted to the main gas line to the GCS/EPS.

The separated water from separator and produces water from tubing is collected in well site produced water storage tank. The stored water is transferred by using a pump to the main water line to EPS/GCS for further treatment. The main water lines and gas lines from different well sites are connected to water manifold and gas manifold at GCS/EPS respectively. The wet gas from the gas manifold is passed again through the gas separator for gravitational separation of water-gas mixture. The separated gas is diverted to the gas filter at GCS/EPS. The Separated water from gas separator and produced water from water manifold is stored in raw produced water storage tank for further filtration.

4 TREATMENT METHOD OF CBM PRODUCED WATER

The stored produced water is treated by using the method of various filtration and reverse osmosis techniques for other use and disposal.

4.1 Filtration of Raw Water

The raw water is filtered by following steps:

a) *Multi grade filter* (*MGF*) —It contains with different grade sand media to remove the suspended particles;

b) *Iron removal filter* (*IRF*) — It contains sand media with layer of manganese dioxide. MnO_2 reacts with water soluble Fe (II) and converts into insoluble Fe (III) and precipitated out;

c) *Fluoride removal filter* (*FRF*) — It contains with fluoride removal media; and

d) *Filter water storage tank*— Filtrate from FRF will be stored in filter water storage tank.

4.2 Reverse Osmosis of Produced Water

The filtered water is further refined by using the reverse osmosis techniques. Following sequence will be followed in RO process as:

a) *Anti-scalantdosing* — It is used as a treatment to RO feed water for scale inhibition and damage protection to the membrane;

b) *SMBS dosing* — Sodium met bisulphite (SMBS) is used as treatment for de-chlorination of RO feed water otherwise it may damage the polymeric membranes due to chlorine content in water;

c) *Micron cartridge filter MCF-RO* — It will act as a guard filter to the upstream RO unit by removing the suspended impurities if any in the RO feed water;

d) *RO high pressure pumps* — It is used to pressurize the water to the desired level so that salts can separate out from the feed stream in downstream membranes;

e) *RO skids* (*RO* 1*, RO* 2 *and RO* 3*; total* 3 *numbers*) — It consist of RO membranes, allied pumping and valves. At suitable high pressure of the salt side of RO membrane force the water across semipermeable RO membrane to leave almost all (>99 percent) of dissolved salts behind in the reject scheme. The Purified water stream is called Permeate and water containing dissolved salts is called concentrate. RO I skid concentrate is fed to RO II skid and concentrate of RO II skid is fed to RO III skid.Permeate from each skid is connected to a common header. Conductivity meter measures the conductivity of the permeate water;

f) *pH dosing to the permeate* — Chemical dosing is done for the correction of the predetermined *p*H at permeate header. *p*H meter measures the *p*H of permeate water; and

g) *Treated water tank* — Permeate of all three RO skids is connected to a common header which is directed to treated water tank.

5 UTILITY AND DISPOSAL OF TREATED WATER

CBM produced water can be utilized in other various purpose. The unused treated water is disposed of by many ways as:

a) The treated water can be utilized for HF jobs, workover operations, fire tender etc for the operational use;

b) As per the *Environment Protection Rule*, 1986 the treated water can be disposed of by re-injection into the abandoned well below the depth of 1000 m;

c) The filtered produced water can be disposed of through evaporation from evaporation tank at GCS/EPS by using sprinkler; and

d) The produced water can be disposed of to the river after treatment.

ANNEX A

(*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 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*)
Essar Oil and Gas Exploration and Production Limited, Durgapur	SHRI VINEET SINGHAL SHRI VIKRAM A. GODAY (*Alternate*)
GAIL (India) Limited, New Delhi	SHRI RAJESH BAGARIA SHRI A. K. PORWAL (*Alternate*)
Great Eastern Energy Corporation Limited, Asansol	SHRI ANOOP GUPTA SHRI PRIYARANJAN PATRA (*Alternate*)
Indian Institute of Technology (ISM), Dhanbad	SHRI R. M. BHATTACHARJEE SHRI D. P. MISHRA (*Alternate*)
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

Bureau of Indian Standards

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