青岛创梦仪器有限公司

Qingdao ChuangMeng Instrument Co., Ltd.

固相含量测定仪
Oil and Water Retort

使用手册

Instruction Manual

版本 1.0
Version 1.0

请你仔细阅读《使用手册》，正确掌握本产品的安装和使用方法。阅读后请将本《使用手册》妥善保管，以备今后进行检修和维护时使用。

Carefully read this User Manual to learn how to install and use the product correctly. After reading, properly keep the User Manual as a reference for future maintenance and repair.

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Ⅰ.概述

固相含量测定仪是用来分离和测定钻井液样品中水、油和固相体积的仪器。是了解固相浓度和组成水基钻井液粘度、滤失控制的基础。其特点为结构简单，操作方便，是实验室和现场理想适用的专用仪器。

Ⅱ.型号及规格

型号	名称
1401 (ZNG-A)	固相含量测定仪

Ⅲ.仪器的主要技术参数

名称	技术参数
电源	220V 50/60Hz
功率	100W
蒸馏器容量	20±0.2ml

Ⅳ.仪器的结构及工作原理

A.组成部分

1.蒸馏器：不锈钢材料精制而成。

2.液体冷凝器：具有足够的容量以便油和水的蒸汽在离开冷凝器之前冷却至蒸发温度以下。

3.加热棒组件：具有足够的功率以便在 15 分钟之内将样品温度升至液相蒸发温度以上，而不致使固相沸腾出来。

4.量筒：容量 20ml%、精度±0.2ml。

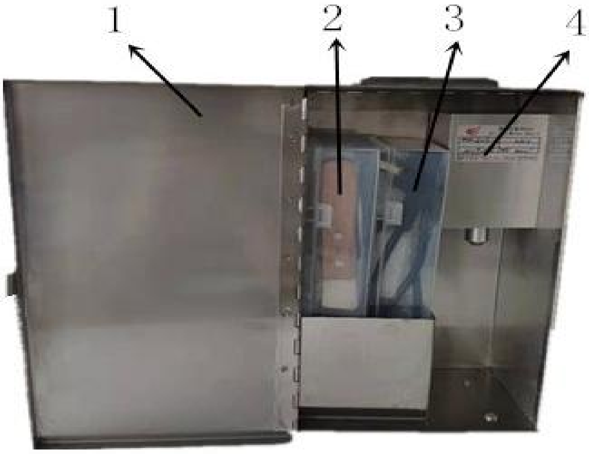
5.试管刷：清洗量筒用的毛刷。

6.刮刀：用来刮取蒸馏器内剩余的固相成分。

7.杯架：当蒸馏器被加热用其拿取蒸馏器。

8.箱体：采用全不锈钢材料制成，固定盛装其他部件用的容器。

序号	名称及规格	序号	名称及规格
1	箱体组件	3	量筒、毛刷、电源线
2	蒸馏器组件、取杯器、刮刀	4	冷凝体组件



B．固相含量测定仪结构图

C.工作原理

在蒸馏器内加热已知体积的水基钻井液样品,使其液相成分蒸发,而后使之冷凝并收集在量筒内,液体体积直接从量筒中油相和水相的读值确定。总的固相体积（悬浮的和溶解的）从差值（样品总体积ー液相体积）得到。由于任何溶解的固体将留在蒸馏器内。所以必须经过计算才能确定悬浮固相体积。也能通过计算得到低比重固相和加重材料的相对体积。

Ⅴ.仪器的操作

1.检查仪器各部件是否清洁干燥，否则应重新清洗并干燥。
2.取有代表性的样品，通过马氏漏斗粘度计的 12 目重筛倒入容器中。充分搅拌样品，排出空气，使样品混合均匀。
注：样品不可以是含油量过高的泥浆。
3.用清洁的注射器或直接将样品注入蒸馏器杯中，应缓慢注入以避免混入空气。用平尺将液面与蒸馏器杯上端刮平，使所取样品的体积为 20ml。
4.用湿布擦净蒸镏器杯的丝扣，将带丝扣的蒸发筒拧紧在蒸发器杯上。垂直地握住拧在一起的蒸发器杯和蒸发筒，将加热棒放入筒中并拧紧在蒸发筒上。
注：为保证密封，丝扣上需抹一些润滑油或密封脂。
5.将蒸发筒的排蒸汽嘴紧紧插入冷凝器的小孔内。将有体积百分刻度的量筒接在冷凝器的排液管口下。
6.将加热棒通电并加热，直至冷凝器再没有液体排出（一般为 15～25min，取决于样品中油的含量和室温）。将加热棒的电源插头拔下。
7.使蒸出的液相冷却至室温，并读取总液相 VL、油和水的体积百分数 VO 和 VW（如油水界面不清晰，可滴入 1～2 滴破乳剂）。
8.拆卸固相含量蒸镏器的各部件，将其清洗并干燥以备下一次使用。可用干净的小细管捅通并清理蒸镏器筒和冷凝器的排气、排液孔，以清除油渍。
9.应用直接读出的测量数据，可以计算钻井液的固相含量。对于两种常用的水基钻井液——淡水钻井液和盐水钻井液，计算的方法不同。

淡水钻井液固相含量计算
1）总固相含量 VS：

$$VS = 100 - (VW+VO), \%$$

式中 VS——淡水钻井液中总固相体积含量（包括粘土地、钻屑等低密度固相和多数情况下为

重晶石的加重材料等高密度固相），%；
VO——由固相含量测定仪测得的钻井液中油的体积含量，%；
VW——由固相含量测定仪测得的钻井液中水的体积含量，%。

2）钻井液中固相的平均密度ρS：

$$\rho S=\frac{100\cdot\rho m-(VW\cdot\rho w+VO\cdot\rho O)}{VS},g/cm^3$$

式中ρS——钻井液中固相的平均密度，g/cm^3；
ρm——钻井液密度，g/cm^3；
ρw——水的密度，通常取得 1.0 g/cm^3；
ρO——油的密谋，通常取暖.48 g/cm^3。

3）钻井液中低密度固体（包括粘土和钻屑）的体积含量 VLG：

$$VLG=VS\frac{\rho WM-\rho s}{\rho WM-\rho LG},\%$$

式中 VLG——钻井液中低密度固体（包括粘土和钻屑）的体含量，%；
ρWM——加重材料的密度，g/cm^3
ρs——钻井液中固相的平均密度，g/cm^3
ρLG——低密度固体的密度（可实测求得或设ρLG=2.60 g/cm^3），g/cm^3.

4）钻井液中加重材料的体积含量 VWM：
VWM=VS-VLG，%

$$VWM=VS\frac{\rho s-\rho LG}{\rho WM-Plg},\%$$

5）钻井液中低密度固体的重量含量 WLG：
WLG=10（VLG×ρLG），kg/m^3
WLG=3.5（VLG×ρLG）,1b/bbl

6)钻井液中加重材料的重量含量 WWM:
WWM=10(VWM×ρWM) ，kg/m^3
WWM=3.5(VWM×ρWM) ，1b/bbl

盐水钻井液的固相和液相含量的计算
1）盐水钻井液滤液的密度ρWC：
ρWC=1+0.00000109·CCl
式中ρWC——盐水钻井液滤液的密度，g/cm^3
CCl——钻井液滤液分析得出的钻井液中 CL^- 的浓度，mg/L
ρWC——density of brine drilling filtrate, g/cm^3

2)盐水钻井液中修正了的总固相体积含量 VSC：

$$VSC=VS-VW\left(\frac{CCl}{1680000-1.21\cdot CCl}\right)$$

式中 VSC——含盐钻井液中修正了的总固相体积含量（减去了盐的体积），%
VS——固相含量测定仪测出的总固相体积含量，%
VW——固相含量测定仪测出的水的体积含量，%

3)盐水钻井液中低密度固体体积含量 VLG：

$$VLG=\frac{1}{(\rho WM-\rho LG)}[100\cdot\rho WC+VSC(\rho WM-\rho WC)-100\cdot\rho m-VO(\rho WC-\rho O)],\%$$

式中 VLG——盐水钻井液中低密度固体体积含量，%

ρWM——加重材料密度，g/cm^3；

ρLG——低密度固体密度，g/cm^3；

ρWC——盐水钻井液滤液的密度，g/cm^3；

VSC——盐水钻井液中修正了的总固相体积含量，%;

ρm——盐水钻井液的密度，g/cm^3；

VO——固相含量测定仪测出的油的体积含量，%;

ρO——油的密度，g/cm^3。

4)盐水钻井液中加重材料的体积含量 VWM：

VWM= VSC- VLG，%

式中 VWM——盐水钻井液中加重材料的体积含量，%

5)盐水钻井液中低密度固体重量含量 WLG：

Weight content of low-density solid in brine drilling fluid WLG：

WLG=10（VLG×ρLG），kg/m^3

WLG=3.5（VLG×ρLG），1b/bbl

6)盐水钻井液中加重材料的重量含量 WWM：

WWM=10（VWM×ρWM），kg/m^3

WWM=3.5（VWM×ρWM），1b/bbl

Ⅵ.仪器的维护与保养

1.清洗各部件并干燥待用，仪器置于干燥环境中。

2.移动、维修或保养仪器时。要轻拿、轻放，以免造成部件变形影响精度和使用。

3.加热棒不可摔碰，轻拿轻放，以防损坏加热棒。

4.加热时通电时间不宜过长，一般蒸馏约 40 分钟。

5.蒸馏杯和套筒之间的密封面不要损伤以免影响密封。

Ⅶ.故障的判定与排除

故障 Fault	原因 Reasons	维修方法 Maintenance methods
蒸馏器组件通电不加热	加热棒坏	用万用表Ω档测量加热棒两端有无阻值，若无阻值加热棒线烧断，更换加热棒.
	电线插头接触不好.	检查电线接头组件各插头是否牢固插牢.

Ⅰ.Summary

Oil and Water Retort is used to separate and determine the volume of water, oil and solid phase in the well drilling fluid sample, which is the foundation to know the solid phase concentration and the viscosity and filtration control of water base drilling fluid. It is characterized by simple structure and easy operation, which is an ideal and special instrument in the laboratory and field.

Ⅱ. Model and specification

Model	Name
1401 (ZNG-A)	Oil and Water Retort

Ⅲ. Main technical parameters of the instrument

Name	Technical parameter
Power Supply	220V 50/60Hz
Power	100W
Capacity of distiller	20±0.2ml

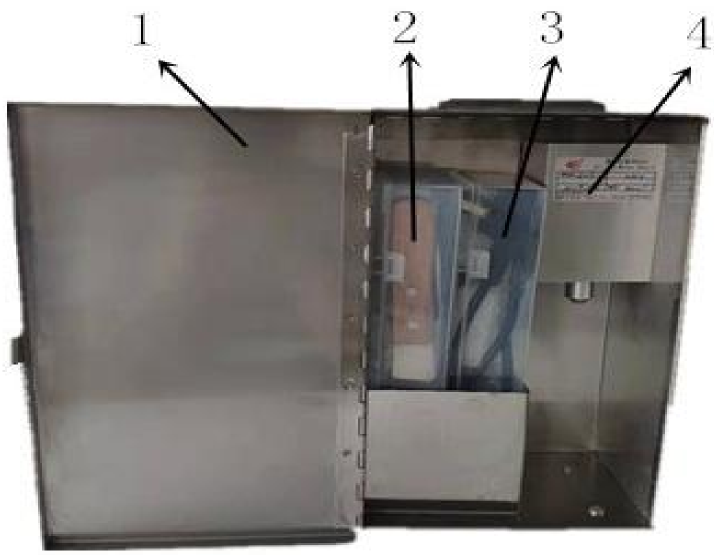
Ⅳ. Structure and working principle

A. Constituent parts

1. Distiller: made from stainless steel materials.
2. Liquid condenser: it has enough capacity so as to facilitate the vapor of water and oil to cool down below the evaporating temperature before leaving the condenser.
3. Heating rod component: it has enough power to raise the sample temperature above the evaporating temperature of the liquid phase in 15min without causing the solid phase to boil out.
4. Measuring cylinder: capacity: 20ml%, accuracy: ±0.2ml.
5. Test-tube brush: the brush for cleaning the measuring cylinder.
6. Scraper: it is used to scrape the remaining solid components in the distiller.
7. Cup holder: it is used to take the distiller when the distiller is heated.
8. Box: the container made from all stainless steel material, and fixedly hold other parts.

No	Name	No	Name
1	Box assembly	3	Measuring cylinder 20ml; Brush; power cord
2	Distiller assembly; Scraper; Cup fetcher	4	Condensate assembly

B． Structure chart



C. Working principal

First, heat a given volume of water-based drilling fluid sample in the distiller to evaporate the liquid composition of the sample; second, condense the vapor and collect it in the measuring cylinder, the liquid volume can be directly known from the measuring cylinder through its oil and water phases reading. The total solid volume (suspended and dissolved) is obtained from the difference (the total volume of the sample-the liquid phase volume). As any dissolved solid will remain in the distiller, the volume of suspended solid must be done to determine through calculation. The relative volume of the low gravity solid materials and the weighting material can also be calculated.

Ⅴ. Operation

1. Check whether all parts of the instrument are clean and dry or not, or the instrument should be cleaned and dried again.
2.Select a typical sample and pour it into the container through a 12-mesh sieve of a marsh funnel viscometer. Stir the sample thoroughly, discharge the air and mix the sample well.
Note: slurry containing excessive oil content can not be taken as sample.
3.Inject the sample into the distiller cup directly or by a clean inspection syringe, and the sample should be injected slowly to avoid mixing with air. Use a levelling ruler to scrap and smooth the liquid level and the upper end of the distiller cup, taking 20ml liquid sample.
4.Wipe the screw thread of the distiller cup with a damp cloth, screw down the evaporating tube with screw thread onto the distiller cup. Next, firmly hold together the evaporating tube and the distiller cup vertically, then put the heating rod into the evaporating tube and screw it on the tube.
Note: to ensure the sealing, the screw thread needs to be applied with some lubricating oil or sealing grease.
5.Tightly insert the exhaust nozzle of the evaporating tube into the small hole of the condenser. The measuring cylinder with volume centigrade scale should be connected to the liquid discharge pipe of the condenser.

6.Energize the heating rod and heat it until the condenser has no liquid discharge (usually 15 to 25min, depending on the amount of oil in the sample and room temperature). Then unplug the heating rod.
7.Cool down the evaporated liquid to room temperature and read the total liquid VL, volume percentage of oil and water VO and VW (if the oil-water interface is not clear, add 1～2 drops of Demulsifier).
8.Disassemble all parts of the solid content distiller, then clean and dry these parts for next time use. Clean and small tubes can be used to clean and poke through the distiller tube and gas vents and drain holes of the condenser for removing the grease.
9.With the direct readings of measured data, the solid content of drilling fluid can be calculated. For two common-used water-based drilling fluids: fresh water drilling fluid and brine drilling fluid, the calculation ways are different.

Calculation of solid phase content in fresh water drilling fluid
1）Total solid phase content VS:

$$VS = 100 - (VW+VO), \%$$

VS——total solid phase volume content in fresh water drilling fluid (including low-density solid phase such as clay soil, drilling cuttings and high-density solid phase such as the weighting materials that are barite in most cases), %;
VO——the oil volume content in drilling fluid measured by solid content determinator, %;
VW——the water volume content in drilling fluid measured by solid content determinator, %;

2）Solid phase average density in drilling fluid ρS：

$$\rho S = \frac{100\cdot\rho m-(VW\cdot\rho w+ VO\cdot\rho O)}{VS}, g/cm^3$$

ρS——solid phase average density in drilling fluid, g/cm^3;
ρm——density of drilling fluid, g/cm^3;
ρw——density of water, normal value: 1.0 g/cm^3;
ρO——density of oil, normal value: 48 g/cm^3。

3）Volume content of low-density solids (including clay soil and drilling cuttings) in drilling fluid VLG：

$$VLG=VS\,\frac{\rho WM-\rho s}{\rho WM-\rho LG}, \%$$

VLG——volume content of low-density solids (including clay soil and drilling cuttings) in drilling fluid, %
ρs——average solid density in drilling fluid, g/cm^3
ρWM——desity of weighting material, g/cm^3
ρLG——desity of low-density solid (obtaining the measured data or supposing ρLG=2.60 g/cm^3) , g/cm^3。

4）Volume content of weighting material in drilling fluid VWM：

$$VWM=VS-VLG, \%$$

$$VWM=VS\,\frac{\rho s-\rho LG}{\rho WM-Plg}, \%$$

5）Weight content of low-density solid in drilling fluid WLG：

$$WLG=10 (VLG\times\rho LG), kg/m^3$$

$WLG=3.5(VLG \times \rho LG)$,1b/bbl

6)Weight content of weighting material in drilling fluid WWM:

$WWM=10(VWM \times \rho WM)$ ，kg/m³

$WWM=3.5(VWM \times \rho WM)$ ，1b/bbl

Calculation of solid and liquid phase content in brine drilling fluid

1）Density of brine drilling filtrate ρWC

$\rho WC=1+0.00000109 \cdot CCl$

ρWC——density of brine drilling filtrate, g/cm³

CCl——density of CL^{-} in drilling fluid through an analysis of drilling filtrate, mg/L

2)Total solid phase volume content in brine drilling fluid revised VSC：

$$VSC=VS-VW\left(\frac{CCl}{1680000-1.21 \cdot CCl}\right)$$

VSC ——total solid phase volume content in brine drilling fluid revised (subtructing it from the volume of salt) , %

VS——total solid phase volume content measured by solid content determinator, %

VW——water volume content measured by solid content determinator, %

3)Volume content of low-density solid in brine drilling fluid VLG：

$$VLG=\frac{1}{(\rho WM-\rho LG)}[100 \cdot \rho WC+VSC(\rho WM-\rho WC)-100 \cdot \rho m- VO(\rho WC-\rho O)],\%$$

VLG——volume content of low-density solid in brine drilling fluid, %

ρWM——desity of weighting material, g/cm³;

ρLG——desity of low-density solid, g/cm³;

ρWC——density of brine drilling filtrate, g/cm³;

VSC——total solid phase volume content in brine drilling fluid revised, %;

ρm——desity of brine drilling fluid, g/cm³;

VO——oil volume content measured by solid content determinator, %;

ρO——desity of oil, g/cm³.

4)Volume content of weighting material in brine drilling fluid VWM

$VWM= VSC- VLG$，%

VWM in the formula——volume content of weighting material in brine drilling fluid, %

5)Weight content of low-density solid in brine drilling fluid WLG：

$WLG=10(VLG \times \rho LG)$，kg/m³

$WLG=3.5(VLG \times \rho LG)$，1b/bbl

6)Weight content of weighting material in brine drilling fluid WWM：

$WWM=10(VWM \times \rho WM)$，kg/m³

$WWM=3.5(VWM \times \rho WM)$，1b/bbl

Ⅵ. **Maintenance of the instrument**

1. Clean and dry all parts. The instrument is stored in a dry place
2. When moving, repairing or maintaining the instrument, the instrument must be handled with care to avoid any deformation of the parts and components affecting the accuracy and use.
3. Heating rod should be gently handled, free from any damage to the rod.
4. Heating time should not be too long, the distillation generally lasts for about 40 minutes.
5. The sealing surface between the distilling cup and the sleeve shall not be damaged so as not to affect the sealing.

Ⅶ. Troubleshooting procedures

Fault	Reasons	Maintenance methods
Distiller assemble at power-up state doesn't heat	Heating rod breakdown	Use the multimeter to measure the resistance at the two ends of the heating rod. Replace the heating rod if there is no resistance for the burn-out of the heating wire.
	Bad connections at plugs of electric wire.	Check whether all wire connections are securely fixed.

青岛创梦仪器有限公司 装箱单

Qingdao Chuangmeng Instrument Co., Ltd. Packing list

生产企业：青岛创梦仪器有限公司
Manufacturing enterprise: Qingdao Chuangmeng Instrument Co.,Ltd.
生产地址：青岛市城阳区流亭街道兴海路 3 号
Production address: No. 3 Xinghai Road, Liuting Street, Chengyang District, Qingdao
主机型号:
Model of the main motor:
出厂编号：
Manufacturing No:

序号 No	编号	名称及规格 Name and specification	数量 Qty	备注 Remarks
1		箱体 Box body	1	
2		蒸馏器 Distiller	1	
3		计量盖 Metering lid	1	
4		刮刀 Scraper	1	
5		量筒支架 Measuring cylinder bracket	1	
6		量筒 20ml Measuring cylinder 20ml	1	
7		电源线 Power cord	1	
8		毛刷 Brush	1	
9		取杯器 Cup fetcher	1	
10		蒸馏杯 20ml Distilling cup	1	
11		合格证 Certificate	1	
12		装箱单 Packing list	1	
13		使用手册 Operation manual	1	