石油科技英语丛书

Petroleum Technical English Series

江淑娟　吴松林　主编

油田开发英语

Oilfield Development English

石油工业出版社
Petroleum Industry Press

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前　言

随着石油工程国际合作项目的日益增多，越来越多的石油工程科技人员需要提高英语交流水平，从而了解国际石油经济的新进展，成功地从事国际合作业务，参与国际竞争。但目前市场尚缺乏适于自学，且石油专业涵盖面较广的英语阅读教材。为此，我们编写了一套《石油科技英语丛书》，分为石油勘探英语、石油钻井英语、油田开发英语、石油化工英语和石油经济与管理英语五个分册。这五个分册基本涵盖了石油工业各方面的词汇和术语，每一分册原文均选自英语国家原版刊物，语言地道、准确，疑难语法现象及语言点均配以注释，阅读理解练习的设计科学、合理，有利于阅读理解能力的快速提高。此外，所有原文均配有准确流畅的译文，读者可借此进一步提高阅读理解的准确性，也可以通过翻译练习提高翻译能力。

有了这套教程，石油工作者就可以随时随地进行英语自学，尽快掌握本专业常用术语、词汇及表达法等，更顺利地进行对外合作业务。本教程编写过程中，广泛参阅了国际最新石油科技杂志和专著，选材具有新颖性和实用性，语言技能训练根据学习者的专业需要而有所侧重，适用对象范围广，可供石油、石化科技工作者使用，也可供大专院校师生等做ESP（English for Specific Purposes/专门用途英语）教材或参考书使用，更值得作为资料情报馆藏。

本书由江淑娟、吴松林担任主编，陈月明、杨培荣担任副主编，参加编写的还有田树宝、李淑霞、吴晓东、陈德春、张勇恺。

由于作者水平有限，书中难免存在缺点和不足之处，诚望广大读者批评指正。

江淑娟　吴松林

2002年5月

Contents

Chapter 1 Elements of Petroleum Reservoir

1.1 Permeability

The basics of permeability established in the case of[1] a conventional reservoir remain valid[2] in the case of a fractured reservoir. But in the presence of two systems (matrix and fractures), permeability may be redefined as matrix permeability, fracture permeability and system (fracture-matrix) permeability.

This redefinition of permeability may create some confusion especially concerning fracture permeability, which[3] may be interpreted either as single fracture permeability or as fracture network permeability, or sometimes as fracture permeability of fracture-bulk volume. Therefore, the various expressions of permeability will be examined and discussed in detail.[4]

1. Intrinsic (内在的) fracture permeability, K_{ff}

The intrinsic fracture permeability is associated to[5] the conductivity[6] measured during the flow of fluid through a single fracture or through a fracture network, independent of[7] the surrounding rock (matrix). It is, in fact, the conductivity of a single channel (fracture) or of a group of channels (fracture network). In this case the flow cross section is represented only by[8] the fracture void areas.

2. Conventional fracture permeability, K_f

The intrinsic fracture permeability, as discussed above, disregards[9] the rock bulk volume associated to the single fracture or to the group of fractures; on the contrary[10], in the conventional fracture permeability (based on the classic Darcy definition) the fracture

and the associated rock bulk (容积，整体) form a hydrodynamic[11] unit.

3. Permeability of fracture-matrix system

The permeability of a fracture-matrix system may be represented by the simple addition of the permeabilities of matrix K_m and fractures K_f,

$$K_t = K_m + K_f$$

Notes

(1) in the case of 就……来说，根据……

(2) remain valid 仍然有效

它的主语部分是 the basics of permeability, established in the case of a conventional reservoir 是过去分词短语，作定语

(3) which 引导非限定性定语从句，修饰 fracture permeability

(4) in detail 详细地，详尽地

(5) is associated to … 与…相关

(6) conductivity *n*. 传导性

(7) independent of 与…无关的，前面省略 be 动词"is"

(8) is represented by 由…表示

(9) disregard *vt*. 不理，不顾，无视

(10) on the contrary 相反地，反之

(11) hydrodynamic *a*. 流体动力学的

Exercise

Directions: Decide whether the following statements are true or false.

1. There are different definitions for permeability.

2. The expressions of permeability are not complicated.

3. The intrinsic fracture permeability discusses the rock bulk

volume.

4. A hydrodynamic unit consists of the fracture permeability and rock bulk.

5. The permeability of matrix system refers to K_t.

1.2 Connate Water Saturation

The connate water (共存水) saturation is by definition[1] the water saturation existing in the reservoir at discovery. It is general but not always true that the connate water saturation is so low that it has no permeability; that is, water does not flow upon production. The value of connate water saturation determines by difference the volume of reservoir oil in place.

When wells are drilled by using a water-base mud, the water filtrate[2] serves to increase the water saturation in the formation adjoining the hole as well as in any rock sample being cored. This complicates connate water evaluation by well logging techniques. Cores cut with water-base mud cannot give a reliable estimate of the reservoir connate water saturation. On the other hand, cores cut with an oil-filtrate mud can give an accurate estimate of connate water saturation for those formation containing immobile connate water. Another reliable technique for obtaining reservoir water saturations utilizes[3] gas-cut cores. Any evaporation of water contained in the core sample by the gas[4] is generally insignificant.[5]

Another technique, termed the evaporation method, has been proposed for determining the reservoir connate water saturation. This method is limited to water-wet rocks, however, and even in this case determines[6] not the connate saturation but the maximum saturation at which water flow does not occur.

In performing meaningful laboratory relative permeability tests, the magnitude[7] of the reservoir connate water saturation is impor-

tant. Laboratory experience has shown that the connate water saturation in preferentially oil-wet cores has no effect on[8] the relative permeabilities as long as[9] the connate saturation is less than about 20 percent PV. In preferentially water-wet rock, the initial water saturation has a definite effect upon the measured water-oil relative permeability characteristics. Therefore, in these rocks the interstitial[10] water saturation at the start of testing should closely approximate the reservoir connate water saturation.

Most engineers have encountered the situation in which the water-oil relative permeability curves for the reservoir of concern have a different irreducible connate water (束缚水) saturation than that chosen as the average reservoir value[11]. Should the measured water-oil flow properties be used directly or should they be adjusted in some way to account for[12] the differences in connate water saturation ? The recommended procedure calls for[13] a new set of water-oil relative permeability curves, constructed so that they adhere to[14] the following criteria.

1. The relative permeability to oil is 1.0 and to water is zero at the reservoir connate water saturation.

2. The relative permeability to water at flood out and the water saturation at this point are the same as in the laboratory test results (the relative permeability to oil at flood out being zero, of course).

3. The shape of the individual "reservoir" relative permeability curves is similar to that[15] of the laboratory-developed curves between the two end points of each curve.

Notes

(1) by definition 根据定义

(2) filtrate *vt*. *vi* 过滤

filtration *n*. 滤液

(3) utilize ['ju:tilaiz] *vt*. 利用，utilization *n*. 利用

(4) contained in the core sample by the gas 过去分词短语作定语，修饰 evaporation

(5) insignificant [ˌinsig'nifikənt] *a*. ①小的，微小的，②无关紧要的

(6) determines 作谓语。它的主语是"This method"

(7) magnitude ['mægnitju:d] *n*. 大小，数量

(8) have no effect on (upon)… 对…没有影响的

(9) as long as 只要

(10) interstitial [intə:'stiʃəl] *a*. 空隙的，在裂缝间的

(11) in which…as the average reservoir value 定语从句修饰 situation

(12) account for 解释…

(13) call for 要求，需要

(14) adhere to 依附，坚持

(15) that 代词，用来代替此句开始的"The shape"

Exercise

Directions: For this passage there are some questions or unfinished statements. Each of them is provided with four choices marked (a), (b), (c) and (d). You should decide on the best choice and mark your answer.

1. What is the connate water saturation?
   a. It is the water saturation existing in the reservoir when discovered.
   b. It is the water-oil saturation existing in the formation at discovery.
   c. It is the water volume in the reservoir at discovery.

d. It is the water quality in the reservoir at discovery.

2. We can say that ____.

a. the connate water saturation is so low that it has no permeability.

b. the connate water saturation is so low that it almost has no permeability.

c. the connate water saturation can be estimated by water evaporation.

d. the connate water saturation in reservoir is always close to that in laboratory.

3. In order to obtain reservoir water saturation, ____ can be used.

a. gas-cut cores　　b. water-base mud

c. oil-water-base mud　　d. gas-oil-base mud

4. Which of the following statements is not true?

a. The evaporation method can be used to determine the reservoir connate water saturation.

b. The value of the reservoir connate water saturation is important.

c. The connate water saturation is always less than 20% PV.

d. The evaporation method determines the maximum saturation when water doesn't flow.

5. The article states that ____.

a. The measured water－oil flow properties can be used directly.

b. The relative permeability of water to oil is 1∶1 at flood-out.

c. The relative permeability to oil is no more than zero.

d. The relative permeability of water to oil is 0∶1 at the

reservoir connate water saturation.

1.3 Fluid Content of the Reservoir

Although the structural traps in which oil accumulates exist in various forms[1], the oil usually occurs in association with gas and salt water. However, while some interstitial water is always present in the oil zone, the latter is not always underlain by a continuous body of water. Where a considerable volume of water does underlie the oil in the same sedimentary bed[2] it is referred to as the "aquifer" (含水层) and being under pressure also[3], it[4] contributes to the total energy of the reservoir. The oil itself, when under pressure, contains an appreciable quantity of dissolved gas. The actual amount of gas will be governed[5] by the pressure and temperature inside the reservoir, and the oil is said to be "saturated" if it cannot dissolve more gas under these particular pressure and temperature conditions. On the other hand, the oil is said to be "undersaturated" if it could dissolve more gas at the same pressure and temperature. In many cases there can be more gas in the reservoir than the oil is capable of holding in solution. This extra gas being lighter than the oil[6], will have formed a "gas cap" above the oil accumulation. If the pressure of a saturated oil reservoir is reduced for any reason, gas will come out of solution and, this is an important factor in the production of oil from the reservoir. It is also possible to find accumulations of gas which are not associated with oil, as is the case in the Southern North Sea.

The reservoir crude may range from a very heavy viscous (i.e. thick) oil, containing little or no dissolved gas under very low pressure, to[7] an extremely light, thin, straw-coloured oil containing a large amount of dissolved gas under considerable pressure. The viscosity of the oil depends roughly on its gravity[8] and also to a large