2260601627-62683-18832-137-243

From: Marcia K McNutt <mcnutt@usgs.gov>
Sent: Wed, 4 Aug 2010 15:29:42
To: GS FOIA 0105 <foia0105@usgs.gov>
Subject: Fw: calculation methodology to account compressibility of oil

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----- Forwarded by Janet N Arneson/DO/USGS/DOI on 08/04/2010 03:29 PM -----

From: "Wereley, Steven T." <wereley@purdue.edu>

To: "Bill.Lehr@noaa.gov" <Bill.Lehr@noaa.gov>, Peter Cornillon <pcornillon@me.com>, "Ad >> Ronald Adrian" <rjadrian@asu.edu>, "Onishi, Yasuo" <Yasuo.Onishi@pnl.gov>, "E. D. (Ned) Cokelet" <Edward.D.Cokelet@noaa.gov>, _NOS ORR Help Desk <ORR.Helpdesk@noaa.gov>

Cc: James J Riley <rileyj@u.washington.edu>, Juan Lasheras <lasheras@ucsd.edu>, Alberto Aliseda <aaliseda@u.washington.edu>, "Espina, Pedro I." <pedro.espina@nist.gov>, "Possolo, Antonio" <antonio.possolo@nist.gov>, ira leifer <ira.leifer@bubbleology.com>, Poojitha

Yapa <pdy@clarkson.edu>, Paul Bommer <pmbommer@mail.utexas.edu>, Franklin Shaffer <Franklin.Shaffer@NETL.DOE.GOV>, Marcia K McNutt

<mcnutt@usgs.gov>, Mark K Sogge <mark_sogge@usgs.gov>, "savas@newton.berkeley.edu" <savas@newton.berkeley.edu>

Date: 06/23/2010 01:26 PM

Subject: calculation methodology to account compressibility of oil

Hi all. Ian MacDonald from Florida State has been trying to get a handle on methane emissions lately. I've attached an email string showing correspondence between him, Tad Patzek of Univ. Texas and Mandy Jove of NOAA. From the interchange I'm wondering if we took into account dissolution of gas twice, once in the 0.29 oil volume to total volume ratio and once in the 1.35 volume change factor. It seems that the volume change may be due to dissolution of gas and not to actual density change of the liquid phase.

They copied Paul Bommer on their last email so maybe he can shed some light on this question...

Steve Wereley, Professor of Mechanical Engineering
Birck Nanotechnology Center, Room 2019, 1205 West State Street
Purdue University
West Lafayette, IN 47907

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web page: http://engineering.purdue.edu/~wereley

----- Message from Ian MacDonald <imacdonald@fsu.edu> on Wed, 23 Jun 2010 12:51:08 -0400 -----

To: "Wereley, Steven T." <wereley@purdue.edu>

Subject: Fwd: question--> compressibility of oil

Steve, FYI

---------- Forwarded message ----------
From: Patzek, Tadeusz W <patzek@mail.utexas.edu>
Date: Wed, Jun 23, 2010 at 12:00 PM
Subject: RE: question
To: Ian MacDonald <imacdonald@fsu.edu>
Cc: "pmbommer@mail.utexas.edu" <pmbommer@mail.utexas.edu>

Hi Ian,

OK, so the gas flow rate at the sea bottom conditions is about 40-45% of the oil flow. This follows from the PVT measurements done by Schlumberger and someone else. The compressibility of oil is negligible, but it keeps on losing gas and shrinks considerably. I am copying Dr. Paul Bommer, who has access to the PVT data, because of his work for NOAA. He can be more specific.

Best regards, Tad

From: Ian MacDonald [mailto:imacdonald@fsu.edu]
Sent: Wednesday, June 23, 2010 10:47 AM
To: Patzek, Tadeusz W
Cc: Samantha Joye; Steven Wereley
Subject: Re: question

Tad,
Quick question. How much as a volume percentage would a light sweet Louisiana crude oil like the Macondo product compress between sea-level and

5000 ft seawater?

Thanks! Ian

On Wed, Jun 23, 2010 at 11:34 AM, Ian MacDonald <imacdonald@fsu.edu> wrote:

Hello Tad,

Mandy Joye forwarded your msg, which I really appreciated, but now I need some help. I've been trying to apply the Flow Rate Tech. Group estimates to get at the potential gas release at the top of the BOP where the fluid undergoes the pT drop to ambient seafloor conditions (277.15K and 154.462 bar). I was using the seafloor oil:gas ratio of 0.29. I am attaching my updated calculator so you can see my results. Interestingly, I get 2950 cu ft gas per barrel at STP.

My concern for your comments is that Steve Wereley--who did the particle image velocity analysis was using a 0.4 Oil:gas ratio at the seafloor --he estimated 30-40K bopd released from the top of the BOP after the riser was cut away--in other words as I understand Steve's analysis, he calculates the total volume rate and then reduces this flow to allow for 0.4 Oil:gas.

It seems like you are suggesting that Steve's estimate the flow should actually be increased because you and your colleagues think the volumetric ratio at the top of the BOP should be 2.5 oil:gas. This might significantly change the FRTG estimates if I'm understanding this correctly.

Mandy--this actually doesn't change my calculations very much. My big concern is how to integrate this with the FRTG numbers. Steve says that

the 35000 - 60000 bopd is *at the sea surface* This is really out of line with the seafloor numbers.

Ian

Ian

On Tue, Jun 22, 2010 at 9:06 PM, Samantha Joye <mjoye@uga.edu> wrote:

FYI--this guy is a petroleum engineer at UT. Very sharp guy and has worked on the Macondo reservoir.

mandy

Begin forwarded message:

2260601627-62683-18832-137-243

From: "Patzek, Tadeusz W" <patzek@mail.utexas.edu>

Date: June 22, 2010 6:55:39 PM EDT

To: Samantha Joye <mjoye@uga.edu>

Subject: RE: question

Dear Mandy

The reservoir fluid is supercritical, so it is neither oil and gas. People have determined the initial reservoir pressure (p0=11680 psia) and temperature(T0=243F) by measurement, and taken samples of the reservoir fluid. These samples were brought to surface, and later subjected to changes of pressure and temperature at constant volume or under volume expansion, to determine the bubble point (first appearance of gas) and then the relative amounts of oil and gas as both the sample pressure and temperature change, or just one of these parameters changes. From these experiments we get the amount of gas dissolved in the oil at a given (p,T),

and the amount of evolved gas. It turns out that at the wellhead conditions of the Macondo well, the gas volume is about 40% of the oil volume, so are they flows. If you decompress oil all the way to 14.7 psia, and cool it to 60 deg F, the amount of gas evolved from this oil will be a little less than 3000 standard cubic feet of gas per barrel of gas-free (stock-tank) oil.

I hope that this brief explanation helps.

Best regards, Tad

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