Importance of Barite Selection

The relationship of undesirable drill solids in a sack of low grade barite on a weighted mud systems

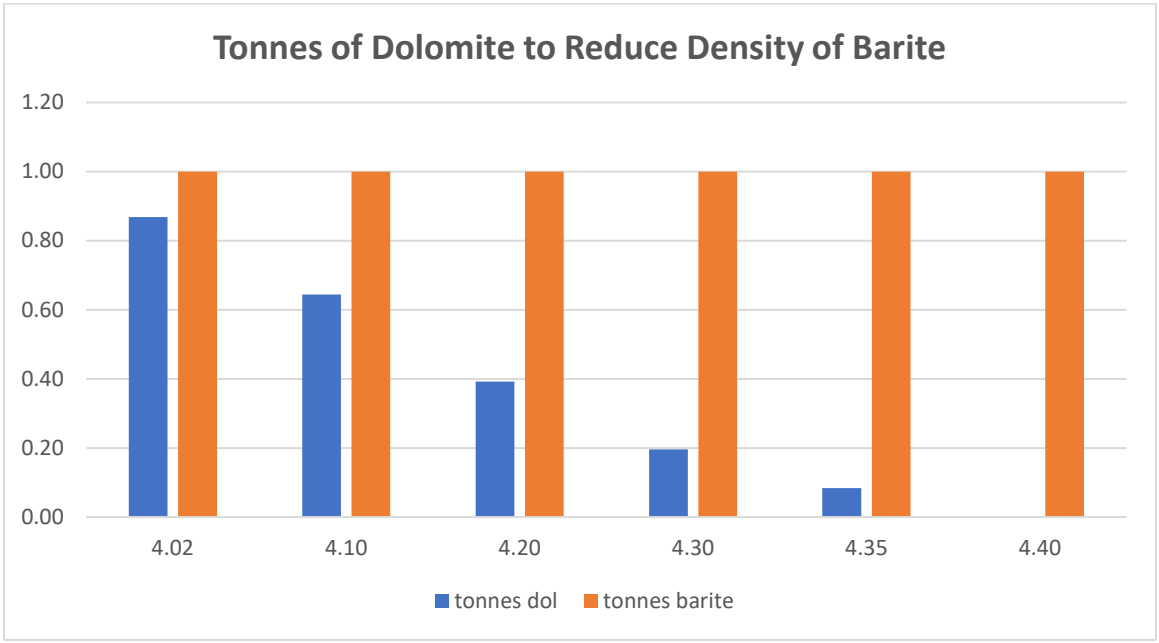
The following is directed to drilling engineers and drilling fluid companies who may want to improve their drilling performance and reduce their drilling costs. The decision on selecting a barite product should be a priority for drilling engineers who are anticipating high mud weights during their drilling programs. When barite is added to the mud system the solids are continuously pulverized into ultra-fine solids after every circulation from pump to bit. There are large amounts of undesirable drill solids (UDS) in various grades of barite.

Using low grade barite for drilling weighted mud systems can increase drilling costs. It has many negative effects from reducing penetration rates, negative effects on mud rheology, wear on pumps and increased costs for removal of undesirable drill solids. Nevada barite can contain high levels of Silica based UDS. It is detrimental to rig components and on the downhole motors and measurement while drilling (MDW) instrumentation equipment.

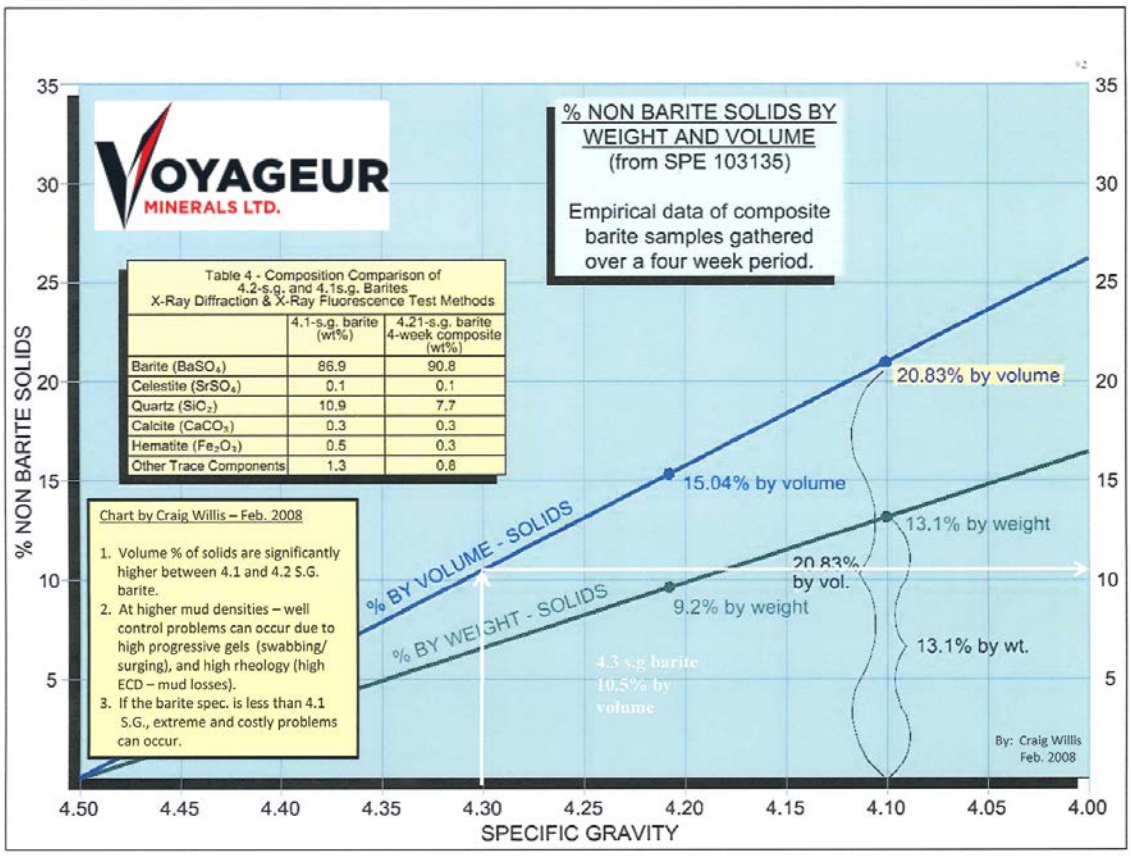
Since 2008 the most important change in the industry has been the switch to horizontal drilling where filter cake and drill string wall contact has resulted in millions of dollars in stuck pipe problems. Formation damage due to excess solids invasion is also a factor when drilling. Mechanical swabbing and surging cause formation damage and kicks can be swabbed in due to thick filter cake.

The density (sg grade) of a barite product is a function of the ratio of barium sulfate to UDS that are mixed with the barite. Based on barite that contains a 2,800 kg/m^3 (sg) waste rock combined with a 4,400 kg/m^3 (sg) barite the following chart shows the ratio of undesirable drill solids that are added to create a barite product.

Office: 587 779 6166 / Suite 255, 339 50th Ave. SE
voyageurminerals.ca / Calgary, Alberta T2G 2B3



The chart below is based on Nevada barite.

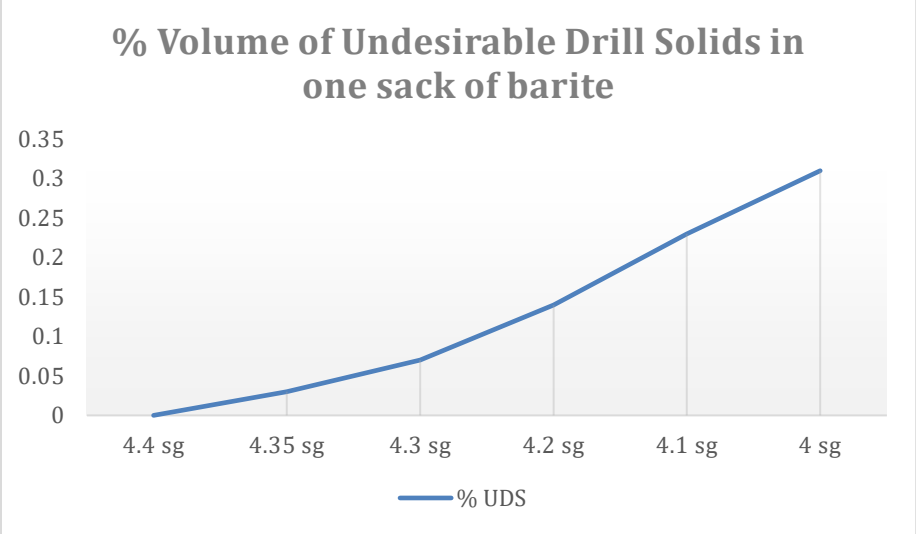


Office: 587 779 6166
voyageurminerals.ca
Suite 255, 339 50th Ave. SE
Calgary, Alberta T2G 2B3

Based on the stated ratios using a 2.8sg UDS the following is the estimated amount of undesirable drill solids that may be introduced to a weighted mud system.

Weighting up 4.2sg barite	**1100 kg/m^3 to 1300 kg/m^3**			
4.2sg barite	**290**	**kg/m^3**		
Cubes Mud	**800**	**m^3 mud**	**Tonnes**	
Kg 4.2 barite	**231,724**	**kg**	**232**	**% UDS**
Kg Undesirable solids (UDS)	**90,372**	**kg**	**90**	**39%**
Weighting up 4.1sg barite	**1100 kg/m^3 to 1300 kg/m^3**			
4.1sg barite	**293**	**kg/m3**		
Cubes Mud	**800**	**m^3 mud**	**Tonnes**	
Kg 4.2 barite	**234,286**	**kg**	**234**	**% UDS**
Kg Undesirable solids (UDS)	**149,943**	**kg**	**150**	**64%**
Weighting up 4.0sg barite	**1100 kg/m^3 to 1300 kg/m^3**			
4.0sg barite	**296**	**kg/m3**		
Cubes Mud	**800**	**m^3 mud**	**Tonnes**	
Kg 4.2 barite	**237,037**	**kg**	**237**	**% UDS**
Kg Undesirable solids (UDS)	**206,222**	**kg**	**206**	**87%**

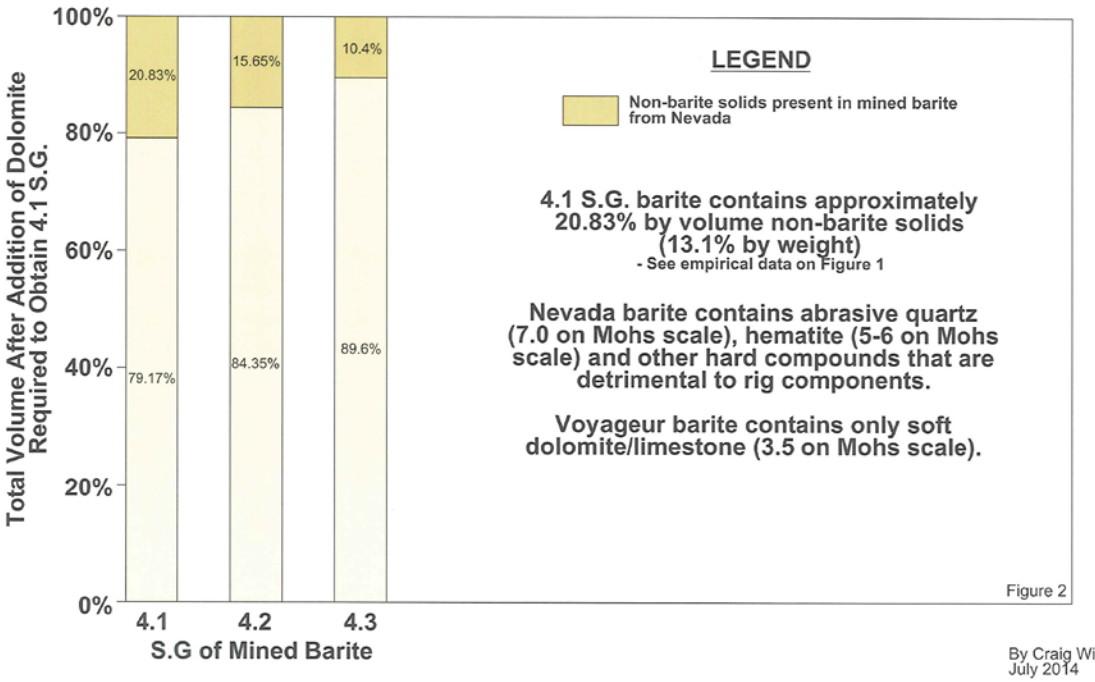
From a drilling fluid perspective, the volume of undesirable drill solids remains constant in each barite grade. The kg of solids fluctuates based on density of the undesirable drill solids.



Office: 587 779 6166
voyageurminerals.ca
Suite 255, 339 50th Ave. SE
Calgary, Alberta T2G 2B3

VOYAGEUR MINERALS LTD.

NEVADA BARITE - % OF NON-BARITE SOLIDS



By Craig Willis
July 2014

Barite is produced from many different host rocks such as shale, dolomite and silica based minerals. The formula that is used to determine the weight of undesirable drill solids is the following:

1. Determine the volume of undesirable drill solids using the following formula
   Volume UDS in above case = $0.23m^3$

$$\text{Density final} = \frac{(D1 \times V1) + (D2 \times V2)}{V \text{ final}}$$

$$4.1 \text{ sg} = \frac{(4.4sg \times 1m^3) + (2.8sg \times 0.23m^3)}{(1m^3 + 0.23m^3)}$$

2. Knowing the density of the undesirable drill solids allows for the calculation of kg of UDS.

   Kg solids = V2 x Density UDS

   $0.23m^3 \times 2{,}800 \text{ kg/m}^3 = 644\text{kg UDS}$

Therefor a barite miner adds/mines 1 tonne of 4.4sg barite to 0.644 tonnes of waste rock = 1.644 tonnes of 4.1sg barite.

3. When weighting up a mud system and 293 kg/m^3 is required the kg of waste rock is calculated by multiplying the total kg of 4.1 barite required x 0.64 tonnes of UDS.

The purpose of this information is to help the drilling engineer plan their well, to become aware of the implications of using lower grade barite and to ensure they understand the importance of selecting the proper grade of barite to maximize their drilling performance. An analysis of the costs of introducing lower grade barite products should be an important factor to consider when high volumes of barite may be anticipated on a well.

Brent Willis, BSc.Eng
COO, Voyageur Minerals Ltd
www.voyageurminerals.ca