

FOAM DRILLING IN NATURAL GAS HYDRATE

by

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The key problem of foam drilling in natural gas hydrate is prediction of characteristic parameters of bottom hole. The simulation shows that when the well depth increases, the foam mass number reduces and the pressure increases. At the same depth, pressure in drill string is always higher than annulus. The research findings provide theoretical basis for safety control.

Key words: foam drilling, characteristic parameters, natural gas hydrate

Introduction

Natural gas hydrate (NGH) is a kind of important resources. With the demand of NGH, foam drilling has already become a hot topic in industry. The key problem of foam drilling is prediction of characteristic parameters in bottom hole [1].

Foam's structure characteristics

The foam is composed of gas and the liquids which contain foam stabilizer and surfactant. The volumetric percentage of gas in the foam is defined as foam mass number (FMN) [2, 3]. According to the FMN values, there are three kinds of foams, *i. e.* unstable, stable, and polystyrene (PS) foams. The foam has a uniform structure, shown in fig. 1 [4].

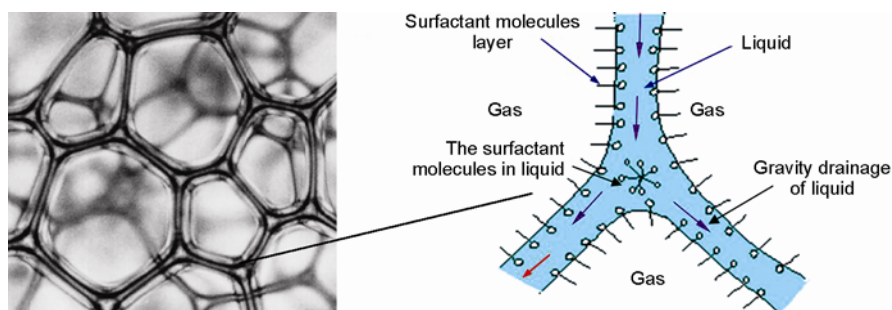


Figure 1. The foam's structure characteristics

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Numerical simulation

It can be seen from figs. 2, 3, and 4, foam pressure in drill pipe are always higher than in annulus. It can be find out that pressure drop of PS foam is the highest and unstable foam is the lowest.

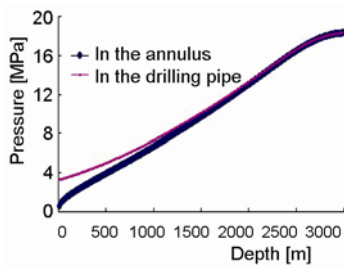


Figure 2. Unstable foam pressure

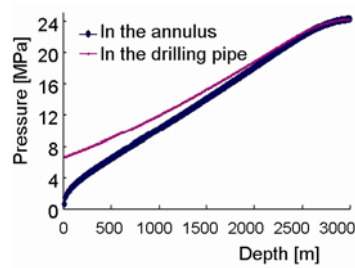


Figure 3. Stable foam pressure

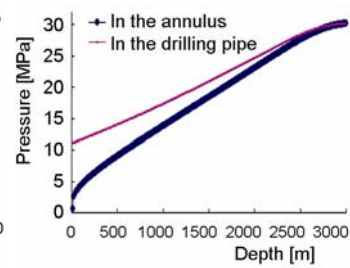


Figure 4. PS foam pressure

It can be seen from figs. 5, 6, and 7, at the same depth, the foam density in the drill pipe is always higher than that in the annulus. The PS foam has the highest bottom pressure.

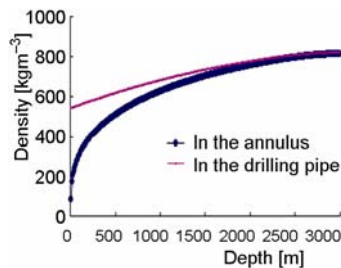


Figure 5. Unstable foam density

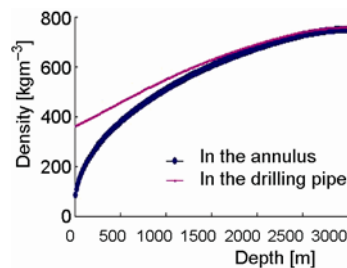


Figure 6. Stable foam density

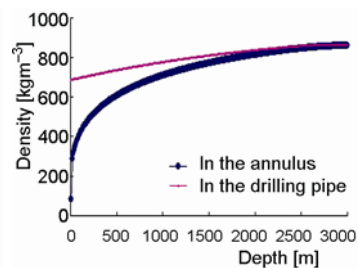


Figure 7. PS foam density

From figs. 8, 9, and 10, FMN in drill pipe is always lower than that in annulus. The FMN mainly depends on temperature and pressure. If pressure is larger, the gas is more heavily compressed, and FMN is lower. If temperature is higher, the gas balloons, and FMN is higher.

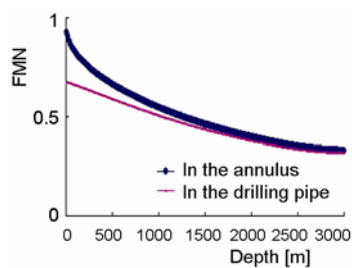


Figure 8. Unstable foam FMN

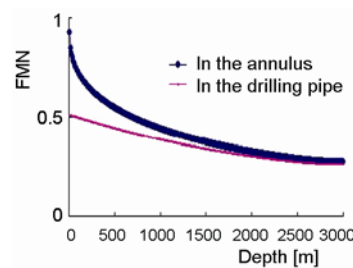


Figure 9. Stable foam FMN

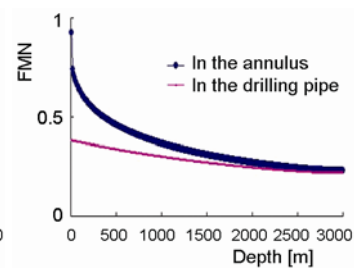


Figure 10. PS foam FMN

Conclusions

- The key problem of foam drilling is to predict parameters in bottom hole.
- The foam density in drill pipe is always higher than that in annulus. The foam has the highest density and pressure at bottom, the FMN in the drill pipe is always smaller than that in annulus.

Acknowledgment

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