



A Study to Increase the Success Rate in Pipeline Deliquification by Foamer Injection



A Del Monaco^{1*}, M Spaccazocchi¹, D Dall'Acqua², G Giacchetta² and B Marchetti²

¹Tecnoconsult Engineering Construction Srl, Italy

²Department of Engineering and Mathematic, Università Politecnicadelle Marche, Italy

Submission: January 11, 2018; **Published:** January 24, 2018

*Corresponding author: A Del Monaco, Tecno consult Engineering Construction Srl, Via Einaudi 22, 61032 - Fano (PU) - Italy,
Email: antonio.delmonaco@tecnoconsult.it

Abstract

The next hydrocarbon production will be given by deep and ultra-deep offshore projects. In this future scenario, the liquid loading becomes an outstanding problem to solve for reducing the possibility to incur in problems such hydrate, reduction of production, corrosion and severe slugging. Currently, the most used technique to solve the problem is the pigging operation, which is if effective but also has several drawbacks. The deliquification by foamer injection has several advantages, among which a relative low cost. The deliquification through foamer injection is not a novelty, but most of the applications are related to gas wells, while the application in pipeline can be considered quite new. The foam formation into a well is easily achieved thanks to the system geometry, with the gas phase passing through the liquid phase accumulated on the bottom well. In pipelines this condition is not met, and the foam formation is dependent by several factors. A research on how these factors affect the foam formation is fundamental to achieve a successful deliquification by foamer injection. A first set of tests were carried out on a test bench, trying to assess the influence of the gas superficial velocity on the foam formation by varying the liquid loading volume. The stability of the generated foam can be considered another key element for the a successful deliquification.

Introduction

In the next future, hydrocarbon production will be given by deep and ultra-deep offshore projects. The liquid loading will require more attention, to prevent hydrate formation, reduce the slugging and increase the production. The foamer injection is probably the most economic technique to address this problem [1]. In some circumstances can also be the only possible solution, when the pig cannot be used for safety or operative reasons [2]. To enhance the deliquification is fundamental to identify a suitable surfactant to maximize the foam formation; nevertheless, the

formation is strongly dependent from several factors that vary along the pipeline, such flow regime, liquid hold up, profile, pressure, etc [3-5]. Experimental research on how these factors affect the foam formation is fundamental to enhance the pipeline deliquification success rate. Here are reported some preliminary results on the minimum gas superficial velocity requested to obtain a foam formation on the test bench at Unicersità Politecnicadelle Marche. To increase the success rate of the application, also the stability of the foam has been evaluated processing images captured along the foam decay.

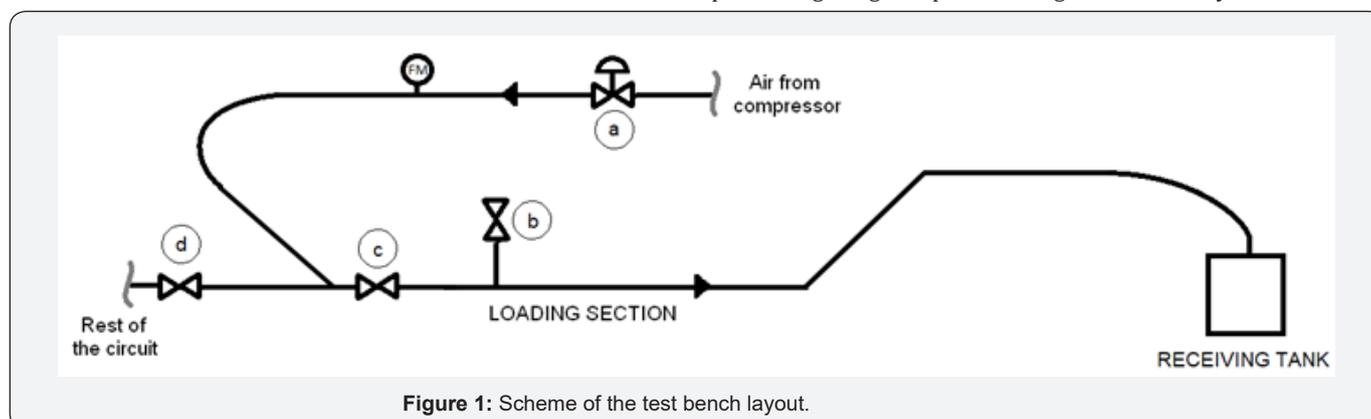


Figure 1: Scheme of the test bench layout.

Material and Methods

The test bench is composed by a PVC pipe, with an ID of 57mm. The tests were performed using freshwater, air and surfactants dedicated to the oil&gas industry. The minimum air velocity requested to have the deliquification of the test bench was measured for three liquid hold up levels. The air velocity was increased starting from zero up to reach the foam formation. During each test the gas superficial velocity was monitored.

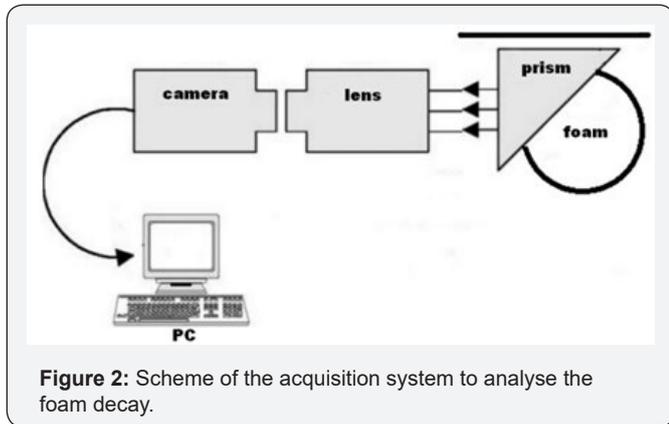


Figure 2: Scheme of the acquisition system to analyse the foam decay.

The foam decay was studied by an image processing tool. A camera with a sampling frequency of 1 frame per minute was used, monitoring the decay in a time frame of 12 hours. The images have been taken through a prism, which allows to see only the bubbles in direct contact with this latter (Figure 1 & 2).

Result

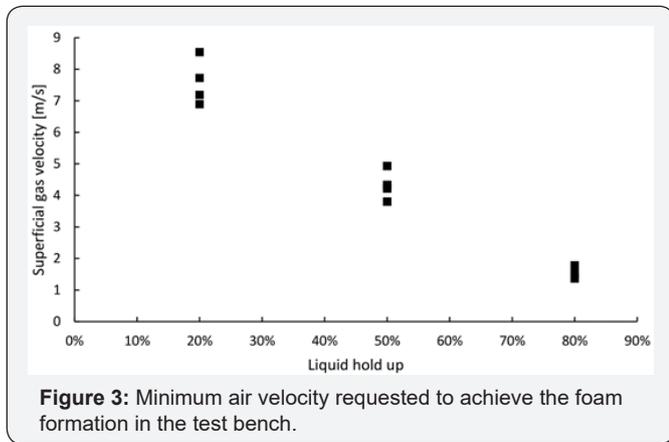


Figure 3: Minimum air velocity requested to achieve the foam formation in the test bench.

Twelve foam formation tests have been carried out on the test bench using 4 different foamers. The effect of the liquid hold up on the foam formation was considered during the experiments. Increasing the air flow velocity, the flow regime passed from stratified up to reach a local slug regime in proximity of the elbow. As expected, no foam formation in stratified regimes has been achieved, but it was necessary to increase the velocity up to reach the local slug regime (Figure 3).

The foams stability along time was characterized by the volume of the foam domain. In the images below are reported the

liquid domain and the foam domain identified by the developed code. In addition the code allows to control the mean diameter of the foam along with the decay (Figure 4 & 5).

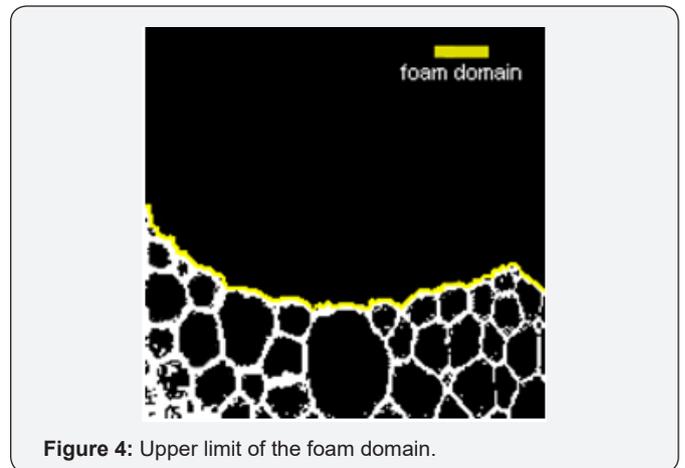


Figure 4: Upper limit of the foam domain.

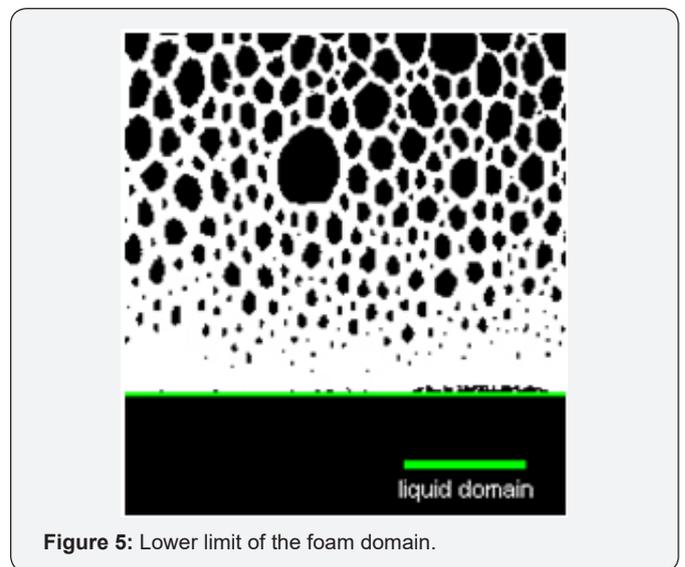


Figure 5: Lower limit of the foam domain.

Conclusion

The preliminary analysis on test bench identify the local slug regime as necessary condition to allow the deliquification of the system. Nevertheless, the obtained result could be affected by the scale effect. In fact, in real applications the volume of foamer injected can be considered quite large, with possible local flooding of pipe section.

The foam stability can be controlled with the developed image processing tool, allowing a direct comparison of the stability for different foamers and test conditions, such as temperature, pressure, foamer percentage.

References

1. Nickens HLJ, Wells M (2008) Gas Well Deliquification. In: (2nd edn), Gulf Professional Publishing, USA, p. 608.
2. O'Donoghue A (2003) Why pigs get stuck, and how to avoid it. Pipes & pipelines International, UK, 48(2): 5-16.

3. Passucci C, Lullo DA, Omarini P, Montini M, Pitassi F, et al. (2015) Foamer application in a 36" gas pipeline: a successful case of liquid unloading. In Gas Well Deliquification Workshop - Denver, Colorado, USA.
4. Benucci M, Corvaro F, Dall'Acqua D, Monaco DA, Giacchetta G, et al. (2015) Foam as possible solution to pipeline affected by liquid loading. XX Summer School "Francesco Turco" - Industrial Systems Engineering, Italy 22: 61032.
5. Dall'Acqua D, Benucci M, Corvaro F, Leporini M, Grifoni CR, et al. (2017) Experimental results of pipeline dewatering through surfactant injection. Journal of Petroleum Science and Engineering, 159: 542-552.



This work is licensed under Creative Commons Attribution 4.0 License
DOI: [10.19080/RAPSCI.2018.04.555635](https://doi.org/10.19080/RAPSCI.2018.04.555635)

**Your next submission with Juniper Publishers
will reach you the below assets**

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats
(Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission

<https://juniperpublishers.com/online-submission.php>