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Optimizing Foaming Agents by Air Compression to Unload a Liquid Loaded Gas Well

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Abstract : When velocity is high enough, gas can entrain fluid and carry to the surface, but as time passes by, velocity drops to a critical point where fluids will start to hold up in the tubing and cause liquid loading which prevents gas production and may lead to the death of the well. Foam injection is widely used as one of the methods to unload liquid. Since wells have different characteristics, it is not guaranteed that foam can be applied in all of them and bring successful results. This research presents a technology to optimize the efficiency of foam to unload liquid by air compression. Two methods are used to explain optimization; (i) mathematical formulas are used to solve and explain the myth of how density and critical velocity could be minimized when air is compressed into foaming agents, then the relationship between flow rates and pressure increase which would boost up the bottom hole pressure and increase the velocity to lift liquid to the surface. (ii) Experiments to test foam carryover capacity and stability as a function of time and surfactant concentration whereby three surfactants anionic sodium dodecyl sulfate (SDS), nonionic Triton 100 and cationic hexadecyltrimethylammonium bromide (HDTAB) were probed. The best foaming agents were injected to lift liquid loaded in a created vertical well model of 2.5 cm diameter and 390 cm high steel tubing covered by a transparent glass casing of 5 cm diameter and 450 cm high. The results show that, after injecting foaming agents, liquid unloading was successful by 75%; however, the efficiency of foaming agents to unload liquid increased by 10% with an addition of compressed air at a ratio of 1:1. Measured values and calculated values were compared and brought about ± 3% difference which is a good number. The successful application of the technology indicates that engineers and stakeholders could bring water flooded gas wells back to production with optimized results by firstly paying attention to the type of surfactants (foaming agents) used, concentration of surfactants, flow rates of the injected surfactants then compressing air to the foaming agents at a proper ratio.

Keywords : air compression, foaming agents, gas well, liquid loading
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