STUDY ON ENVIRONMENTAL IMPACTS OF HYDRAULIC FRACTURING

Amit Das
Department of Petroleum and Mining Engineering
CUET, Chittagong, Bangladesh

Zayed Bin Sultan
Department of Petroleum and Mining Engineering
CUET, Chittagong, Bangladesh

Abstract- Hydraulic fracturing is such kind of method that is used to recuperate the hydrocarbons trapped in lower quality reservoirs i.e. unconventional reservoirs for example tight sand, shale or coal bed methane reservoirs that have the lower permeability. Hydraulic fracturing is considered as a safe method for stimulating the wells as it has a lot of flexibilities in its execution. Successful hydraulic fracturing job will not be achieved until the proper design on hydraulic fracturing parameters is done. There are careful concerns over the environmental impacts associated with this hydraulic fracturing technology that have led to extensive research and studies. This study helps to find out what kind of mitigation or control techniques must be taken into the account for the environmental impacts associated with this hydraulic fracturing treatment.

Keywords – Air Emissions, Surface Spills, Water Withdrawals and Wastewater Management and Disposal.

I. INTRODUCTION

Hydraulic fracturing is such kind of technique which is used to increase the productivity of gas and oil wells It has adverse impacts on atmosphere and public health. In hydraulic fracturing operations, the chemicals used and the wastes generated are called “product.” There are serious hostile effects on the subsurface environment due to the characteristics of these products such as toxicity, volumes, duration of exposure and quantity of the chemicals. On the other hand, the environmental issues and aspects associated with this fracturing treatment cause serious ecological impacts which damage the physical environment drastically.

II. LITERATURE REVIEW

The fracking technology was introduced by different petroleum industries from 1940s with a view to increasing the productivity of wells. A series of legal challenges and lawsuits were concentrated on hydraulic fracturing treatment from the late 1990s through about 2004. There are some issues which contribute to the controversy surrounding hydraulic fracturing that is discussed below: [1]

- Firstly, 1 to 5 million gallons of water require for each frac job in which that water must be gained locally.
- Secondly, with a view to optimizing a frac job the ingredients of the chemical compound used i.e. biocides, scale inhibitors, gels and gel breaker have been concealed due to the toxic properties at high level.
- The soil, groundwater and surface water have been polluted due to the inappropriate storage of chemicals and wastewater.
- The drinking water supplies would be smashed or harmed due to the lack of knowledge about the fracking principle and acts.

- With a view to drilling and fracking wells, there are wide range of heavy equipment used which eventually cause air emission and greenhouse gas emission concerns.

III. ENVIRONMENTAL IMPACTS AND MITIGATION APPROACHES

There are some possible negative environmental impacts associated with this hydraulic fracturing treatment which should be controlled in a proper way to meet the legacy of the hydraulic fracturing operations. [2]

3.1 Water Withdrawals

Fracturing operations demand an extensive amount of fresh water, posing significant challenges to local water sources. The substantial volume needed for hydraulic fracturing within tight timeframes can adversely affect the availability of water for various purposes. Drawing water from streams during drought periods can harm aquatic ecosystems, recreational pursuits, and the essential water supply for communities and industries. Moreover, excessive withdrawal from aquifers can lower pressure, potentially allowing seawater infiltration and the subsequent contamination of the aquifer with high salinity levels..

3.1.1 Mitigation Approaches on Water Withdrawals

The following necessary mitigation approaches should be taken for water withdrawals:

- If anyone treat and recycle the produced and flow back water from the fracturing operations, this will lead to the reduction of fresh water withdrawal.
- Another alternative is to withdraw and store surface water in impoundments during wet seasons.

3.2 Surface Spills

Surface spills occur as a result of various disputable incidents, including tank leaks, overfills, or improper operations. The chemical makeup of these spills can be highly diverse due to the extensive range of chemicals utilized in fracturing operations. The composition largely hinges on the specific fracturing fluid tailored for the location in question. Estimates suggest that chemical concentrations in frac-fluids typically range between 0.5% and 2%.

3.2.1 Mitigation Approaches on Surface Spills

The following necessary mitigation approaches should be taken for water surface spills:

- There should be required sufficient training for using chemicals and crew handling equipment.
- Nontoxic chemicals should be used.
- With a view to containing spills, there should be used appropriate liners.
- For decreasing accidents double walled tanks should be applied.
- Providing site-specific spill prevention control to neutralize any spill.

3.3 Wastewater Management and Disposal

The wastewater produced by fracturing operations is typically disposed of by injecting it deep into formations via injection wells. This method of disposal is often the most economical and has a long history of safe implementation. However, not all areas possess suitable formations for this type of disposal. For instance, while in Texas, wastewater from the Barnett shale can be injected into permeable rocks more than a mile underground, the Marcellus shale region lacks such suitable disposal formations. Moreover, while state and federal regulations impose strict guidelines on the construction and operation of deep injection wells, they do not prohibit injection near fault zones. Injecting large volumes of wastewater near fault zones can potentially lubricate stressed areas, leading to minor earthquakes measuring less than 4 on the Richter scale.

3.3.1 Mitigation Approaches on Wastewater Management and Disposal

The following necessary mitigation approaches should be taken for wastewater management and disposal:

- Ensuring disposal wells are situated at a safe distance from geological fault zones prone to seismic activity.
- Choosing subsurface formations with high porosity and permeability for wastewater injection.

- Implementing impermeable layers above the injection zone to safeguard shallow water aquifers.
- Installing monitoring wells in proximity to the injection site to promptly identify any leaks or migration of injected fluids into aquifers.

3.4 Air Emissions

During the time of production of the fractured wells there are temporary air emissions of hydrocarbons from shale gas wells. Air emissions can also occur as a result of using heavy duty engine and instruments.

3.4.1 Mitigation Approaches on Air Emissions

The following necessary mitigation approaches should be taken for air emissions:

- Employ low-bleed devices to minimize gas emissions.
- Utilize infrared cameras in field operations to promptly detect hydrocarbon leaks for swift repair, thereby mitigating ecological impacts.
- Deploy flash-tank separators, which have the capability to recover 90–99% of methane that would otherwise be flared or released into the atmosphere.

IV.CONCLUSION

It can be said and also bring about a conclusion from the above study that inappropriate hydraulic fracturing treatment will not only cause big economic loss but also lead to the adverse environmental impact. So there should be required adequate knowledge of fracking technology and their working principle. From this study it is clear that the appropriate number of environmentally benign chemicals i.e. green chemicals should be introduced in order to reduce the environmental impacts during the fracture treatment.

REFERENCES

[1] SPE Summit (2011). Hydraulic Fracturing: Ensuring Ground Water Protection. Woodlands, TX, USA, January 27, 2011, pp. 4-5.

[2] C. D. Erle, W. Alam, and N. Begum, Hydraulic Fracturing Explained: Evalution, Implementation and Challenges. Gulf Publishing Company, Houston, pp.73, pp.134-141.