# Iron Material Balance as Effective Scale Control Measure in Stimulation of Unconventional Sour Wells – Underestimated Factors of Proppant Digenesis and Scales

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## ABSTRACT

Iron control during fracturing and acidization using chemical treatment such as chelating and reducing agents is thought of as well understood, however, formation of iron scale after stimulation especially in sour wells is still remaining a surprising challenge. Scale formation could lead to severe formation damage with negative impact on well production. It is operational practice for fracturing and acidization operation that the type and quantity of chelating agent are selected based on the expected iron in the treatment and formation. Which, in certain cases underestimates possible other sources of iron, such as proppant diagnosis and pre-existing scales. This paper presents a case study of a fracturing job in a sour well, which serves as illustration how to establish a material balance for iron. An effective chemical mitigation of iron scale should start by identification all potential sources of iron in the system. These sources should be assessed for the amount and probability of each iron source to contribute to the formation of iron sulfide scale. Values obtained then populate the iron material balance, accounting for all iron entering the well system: such as fracturing fluids and chemicals, tubular (pre-existing corrosion products from mill-scale and atmospheric rusts), formation water, proppant digenesis with leaching of iron, dissolution of formation; versus all iron produced from the well system: such as flow back water, recovered iron scale deposits, and iron scale potentially precipitated in the formation. The exercise to conduct an iron material balance clearly identifies potential sources of iron, evaluates their contributions, and guides the design of a targeted scale control program. Supporting lab studies found, that leaching of iron from proppant, though small in relative proportions, if weighted with the amount of proppant injected, can significantly contribute as potential source of iron. Additionally, for sour wells the partial pressure of H2S present should be sufficiently reflected in the design of the mitigation program, as it directly affects the chemical equilibria of complexation agents and reducers introduced to mitigate iron scale. This case study highlighted that some assumptions on iron sources might have to be reviewed critically. Iron material balance of a well system should be the baseline to design an effective chemical treatment and be a good operational practice to control iron scale.