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Survivability of Optical Fiber for Harsh Environments

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Abstract

Today, optical-fiber systems are used in the oilfield for sensing and telemetry applications. The most commonly used downhole is the distributed temperature sensing (DTS) system which collects permanent real-time temperature well logs. These logs are extremely useful for real-time production allocation, heavy oil thermal recovery (e.g., steam-assisted gravity drainage, SAGD), steam-well management, and well-integrity monitoring.

Unfortunately, optical fibers are not immune to degradation under downhole conditions. Hydrogen, present in the wells because of corrosion or other factors, can attack the optical-fiber components causing attenuation increase. This attenuation can have a negative effect on the performance of the system, such as decreasing accuracy or resolution. Understanding the process and the impact of this degradation is of great importance to the reliable operation of these optical-fiber systems.

This article shows how a combination of controlled testing and modeling calculations can be used to provide an estimation of the attenuation increase expected from the fiber with time and downhole conditions.

Test results for attenuation of optical fiber in hydrogen atmospheres and under downhole temperatures will be shown. The article also provides results from the testing of a new optical fiber that was designed to give a considerable improvement in resistance to hydrogen attack. These results give an order of magnitude improvement in comparison with commercially available optical fibers. Early field tests are consistent with the results of the study.