石油学报 » 2018, **Vol. 39** » Issue (3): 349-356 DOI: 10.7623/syxb201803011

弹性液体胶塞修井防漏机理及应用

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Fluid-loss control mechanism and application of elastic gel plug in well workover

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全文: PDF (0 KB) HTML (1 KB)

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摘要

针对低压油气藏修井液漏失问题，研发了一种具有玻璃态特征的弹性液体胶塞，能显著提高地层承压能力并阻断压井液漏失，防止地层损害，且无需破胶工艺，能实现高效返排解堵。技术原理为地面预交联（泵得进）→井下高温再交联（堵得住）→后期在外力作用下破裂成弹性颗粒（返得出）。实验研究表明：弹性液体胶塞抗温为150℃、抗压为20 MPa、抗盐为30×10^{4}mg/L，能满足盐水配制需求，岩心渗透率恢复值大于90%。现场试验表明：在地层压力系数为0.818、温度为133℃的凝析气井修井时采取弹性液体胶塞技术后，修井持续41 d，未出现气侵上窜，基本无漏失。弹性液体胶塞破裂返排后，憋压试验表明，滤饼暂堵层承压能力达29.4 MPa，气举仅12 h便诱喷成功，生产25 d压力恢复率为92%，产量恢复率达100%，生产恢复能力明显提高。

关键词： 弹性液体胶塞, 玻璃态, 防漏机理, 微观结构, 无破胶, 现场试验

Abstract:

Aiming at the problem of workover fluid loss in low-pressure reservoir, an elastic gel plug in glassy state was developed to significantly improve the formation bearing capacity, prevent the loss of well killing fluid and lower formation damage, and realize high-efficiency flow-back and deblocking without gelout process. The principle of this technology is illustrated as below:ground pre-crosslinking (pumping available)→under-well high-temperature re-crosslinking (plugging available)→fractured into elastic particles by external force (flow-back available). The experimental study shows that the elastic gel plug has a temperature resistance of 150℃, compression resistance of 20 MPa and salt resistance of 30×10^{4}mg/L, able to meet the use of brine preparation, and the regained-permeability value of treated core is over 90%. The field experiment indicates that when using the elastic gel plug for workover in the condensate gas well at the formation pressure coefficient of 0.818 and the high temperature of 133℃, the workover lasted for 41 days and neither upward gas migration nor fluid loss occurred. After the flow-back of the ruptured elastic gel plug, the pressure keeping experiment shows that the pressure bearing capacity of filter-cake temporary plugging layer reached 29.4 MPa, and it only took 12 hours to successful initiate well production when using gas lift. After 25 days production, the pressure recovery rate reached 92%, and the yield recovery rate was 100%, the recovery capacity of production is obviously improved.

Key words: elastic gel plug glass state fluid-loss control mechanism microstructure without gelout process field experiment

收稿日期: 2017-03-17

中图分类号: TE283

基金资助:

中国石油科技创新基金项目（2017D-5007-0202）资助。

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引用本文:

贾虎, 陈昊, 陈波. 弹性液体胶塞修井防漏机理及应用[J]. 石油学报, 2018, 39(3): 349-356.
Jia Hu, Chen Hao, Chen Bo. Fluid-loss control mechanism and application of elastic gel plug in well workover[J]. Acta Petrolei Sinica, 2018, 39(3): 349-356.

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