超高压井防漏治漏工艺在洋渡 3 井的应用

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张代骏. 超高压井防漏治漏工艺在洋渡 3 井的应用. 天然气工业, 2000; 20(4): 47~ 48

摘　要　高压地层钻井需用高密度钻井液去平衡地层高压流体, 但高液柱压力将造成低压地层的井漏, 遇井漏就应采取相适应的措施, 尽快堵住漏层, 避免造成液柱压力降低可能诱发或引起的井下事故。四川盆地东部洋渡溪构造洋渡 3 井在超高压地层钻井中, 据高液柱压力井漏的不同特点, 对钻井液进行降密度、降排量和对可能出现的井漏段预先加入混合暂堵液进行防漏, 用大剂量、高浓度的不同暂堵物混合配制进行关井静置、间断憋挤堵中漏至大漏的防漏治漏工艺技术均收到显著效果。在钻遇异常高压油气井进行主动预防, 科学的应用综合防漏治漏工艺, 能有利于油气层的识别、发现和保护, 是降低钻井成本, 提高综合效益的有效途径。

主题词　四川　东　超高压井　防漏　堵漏　工艺　应用

洋渡 3 井是川东高陡构造区方斗山背斜带洋渡溪潜伏构造上的一口预探井, 该构造有多个压力系统, 地层压力异常和漏喷并存。该井用 Ø215.9 mm 钻头在 $T_1j^2_2$ 上部 3 376~ 3 386 m 井段钻遇异常高压气层, 钻井液密度由 1.75 g/cm^3 提高到 2.36 g/cm^3 才基本平衡气层压力, 但起下钻仍有后效反应。因井下长期使用多达三个扶正器的钻具组合钻井, 为避免高液柱压力造成低压地层的井漏而带来的事故, 通过实践探索出一套在高压复杂井进行防漏治漏的工艺技术, 该井在高压情况下钻进发生 8 次明显井漏, 均一次性堵漏成功并当日见到进尺, 安全钻至井深 5 065 m 完钻未发生大小事故, 在实际应用中取得了显著效果。

川东地区高密度钻井液井漏的特点、原因

1. 高液柱压力造成低压层井漏

在钻遇地层高压流体时, 常用高密度钻井液去平衡高压层压力, 但对低压层将产生高压差造成压裂缝而诱发井漏。在同一裸眼井内高低压差悬殊越大, 井漏越严重。

2. 高液柱压力易造成地层原已存在的裂缝及油气显示层的井漏

川东地区的三叠系至石炭系以碳酸盐岩为主, 是钻探的主要油气层, 由于受地质构造应力牵引作用, 使该段裂缝发育并多为含气层, 在高液柱压力下造成的井漏频繁。

3. 高液柱压力造成的漏速大并可能造成井下复杂及事故

高密度钻井液在井眼内形成高液柱压力, 低压层或有裂缝的层段在高压差作用下使岩层被压裂造成压裂性漏失, 同时可加宽自然裂缝造成大漏, 漏速可达不返。在大漏情况下因井筒内液柱压力的降低可能会造成井下垮塌及压差卡钻或气侵井喷。

深井高液柱压力下的防漏治理对策

1. 降密度、降排量防井漏

降低钻井液密度可减小对低压层的液柱压力。利用钻井液密度与钻井液静止时间和气测全烃值的相互控制关系, 把钻井液密度降到能使井下进行一定的作业, 又不发生严重溢流或井喷的原则下进行欠平衡钻井。

降排量: 在钻遇漏层时立即把排量降低 1/3~ 1/2。可减小钻井液克服上返时环形空间的流动阻力, 降低了对井底的压力, 可减小钻井液的漏失量。这对小漏能起到一定的防漏作用。

2. 预加堵漏物对小漏至中漏进行防漏堵漏

对邻近构造井资料进行分析, 结合本井情况提

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前向钻井液内加入几种不同类型的混合堵漏物,对钻井液进行预处理。对预测的小漏井段加量为2%~3%,对预测的中漏井段加量为4%~5%,这对发生的小漏和中漏能起到钻进堵漏同步进行,减少了损失又钻获了进尺,即使钻遇不返的大漏层也会起到减缓漏失的作用。

3. 大剂量、高浓度、关井静置、间断憋挤堵中漏至大漏

在钻遇漏速大于30 m^3/h以上至不返的大漏层采用大剂量、高浓度、选择粗细颗粒级配加纤维状的不同类型的堵漏物,混合配制进行堵漏,能增加堵漏效果,成功率高,见效快,具体方法如下:

(1)如无条件起钻,应把钻头提离井底50 m以上活动钻具防卡,并每5 min向井内反灌钻井液0.5~1 m^3防井喷。

(2)配制A、B两罐共30 m^3以上达到井内钻井液性能的堵漏基液,含油量应达6%~8%,防堵漏施工作业时发生卡钻。

(3)加入选定的几种不同类型堵漏物,浓度应达到10%以上,A罐内加的堵漏物级配与浓度可偏小2%,另B罐内应增大2%。

(4)钻具下至距漏层顶部30 m以上,先泵完A罐较低浓度的混合物堵漏液,接着泵入B罐较高浓度的堵漏液后再顶替钻井液。这可避免较大颗粒的堵漏物最先封堵住漏层通道表面,使大量堵漏物不能进入漏层而降低堵漏效果和承压能力。堵漏施工中应以50~60 r/min的转速活动钻具防卡。

(5)迅速起钻至安全井段,开泵冲钻具水眼后反灌钻井液至井口,关封井器憋挤钻井液。注意漏入和憋挤入漏层的堵漏液量不超过2/3,泵压控制在4~6 MPa,防憋压过高憋漏其它层段。

(6)关井静置、间断憋挤。压力下降缓慢则每15 min左右憋挤一次,压力下降较快可每30 min左右憋挤一次,关井憋挤3~5 h即可。

对漏速小于30 m^3/h的中漏地层也可采用上述堵漏施工方法,对堵漏液量可适当减小,浓度6%~10%即可。

防漏治漏的现场应用及效果

1. 双降的应用效果

(1)降钻井液密度减小井内液柱压力。洋渡3井用密度为1.75 g/cm^3钻井液在井深3 376~3 386 m井段钻遇异常高压气层,把密度提高到2.36 g/cm^3才基本平衡气层压力。为避免低压层的频繁井漏,利用钻井液密度、气测全烃值、钻井液静止时间的相互控制关系,把钻井液密度逐渐降至2.20~2.18 g/cm^3减小井内液柱压力,气测全烃值维持在35%~60%的范围内钻井液不会涌出喇叭口,能保持井下欠平衡的钻井作业。因钻井液密度降低减小了井内液柱压力,能预防部分较小漏失及压裂性漏失。

(2)降排量钻进减小对井底的循环压力。在钻遇漏层时应立即降低钻进排量,能起到减小钻井液克服上返时对环形空间的流动阻力,并同时可减少钻井液的漏失量。该井在钻遇漏层后多次采用降排量的方法均收到一定效果。

2. 预加堵漏物的随钻应用及效果

该井据邻近资料预测,茅一段地层可能发生井漏。对钻至预测的几个井漏段前向两罐正用高密度钻井液48 m^3中加入桥塞1.5 t、单向封闭剂1 t、浓度5.2%,混合搅拌均匀。在井下带有3个扶正器的钻具组合钻进未发现井漏,把预加混合堵漏物的钻井液泵入井内钻进至井深4 779.30 m出现井漏,漏速13.2 m^3/h。立即降排量为10~12 L/s进行钻进观察,预加堵漏物的钻井液每循环到井底一次,井下漏速就明显减小,后逐渐停漏恢复正常,预加堵漏物随钻堵漏成功。

该井几次预加混合堵漏物泵入井内钻进,均取得理想效果。后经电测资料解释,因钻井液密度太高造成地层压裂缝达20多处,因钻井液进行了预加堵漏物的处理,故未发现明显漏失。

3. 用高浓度混合堵漏液进行关井静置、间断憋挤堵中漏至大漏的现场应用效果

(1)基本情况。用密度2.18 g/cm^3的钻井液并带有3个Ø215 mm扶正器的钻具组合,钻至井深4 690.50 m发生井漏失返,反灌钻井液井口不见液面。

(2)配制混合堵漏液。配制密度2.20 g/cm^3的堵漏基液两罐38 m^3,含油量7%。加入桥塞物3 t、单向封闭剂1.2 t,混合搅拌均匀。A罐浓度10%,B罐浓度12%。

(3)堵漏方法及效果。在配制混合堵漏液时井内活动钻具防卡,并每10 min向井内反灌钻井液1~1.5 m^3保持井内液柱压力防井喷。原钻具在井深4 634 m处注A罐堵漏液完后接着注B罐堵漏液共30 m^3,替钻井液37 m^3起钻至安全井段再替6 m^3冲钻头水眼,反灌钻井液至井口。关井憋挤钻井液套压升至3 MPa,后每间隔15 min憋挤一次,共憋挤4次,憋入量3.1 m^3,套压升至5.7 MPa稳压3 h不降。

(收稿日期　1999-12-28　编辑　钟水清)

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APPLICATION OF LOST CIRCULATION PREVENTION AND CONTROL TECHNOLOGY FOR SUPERHIGH PRESSURE WELL TO WELL YANGDU-3

Zhang Daijun (East Sichuan Drilling CO., Sichuan Petroleum Administration). *NATUR. GAS IND.* v. 20, no. 4, pp. 47 ~ 48, 7/25/2000. (ISSN 1000-0976; **In Chinese**)

ABSTRACT: For the drilling in high-pressure formation, it is necessary to use high-density drilling fluid to balance the high-pressure fluid in the formation, but the high liquid column pressure will cause mud loss in low-pressure formation. When lost circulation occurs, the appropriate measures must be taken to block off the leakage formation as soon as possible to avoid possible downhole accident and complexity due to the reduced liquid column pressure. In the drilling of well Yangdu-3 in superhigh-pressure formation in Yangduxi Structure in the east part of Sichuan basin, in the light of the different characters of the lost circulation due to the high liquid column pressure, the leakage prevention was carried out by reducing the density and flow rate of the drilling fluid and by adding temporary blocking agent at the possible leakage interval beforehand. The lost circulation prevention and control technology that the great-dose and high-concentration mixture of different temporary blocking agents is first pumped into borehole, and then the well is shut-in, the mixture is kept static and intermittently squeezed into the medium to strong leakage intervals to block them has obtained an obvious effect. When the abnormally high-pressure oil and gas wells are drilled, taking the initiative in preventing drilling fluid loss and scientifically applying the combined leakage prevention and control technology are favourable for identifying, discovering and protecting oil and gas-bearing formation, being an effective way to reduce the drilling cost and raise the overall effect.

SUBJECT HEADINGS: Sichuan, East, Superhigh pressure well, Antileakage, Loss circulation control, Technology, Application

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A STUDY ON APPLICATION OF 2-D FINITE ELEMENT HEAT FLOW MODEL TO PERFORATED WELL

Lian Zhanghua, Meng Yingfeng and Tong Min (Southwest Petroleum Institute). *NATUR. GAS IND.* v. 20, no. 4, pp. 49 ~ 53, 7/25/2000. (ISSN 1000-0976; **In Chinese**)

ABSTRACT: In this paper, the 2-D finite element heat flow models of perforated well and open hole well are established by simulating the flow field of the fluids in perforated wells with heat flow field. Based on this model, the distribution of the fluid flow rate field under the condition of ideal open hole well model is analyzed and the linear flow rate (Q_r) at the exit of the model is obtained, providing a comparative datum for the linear flow rate (Q_p) at the exit of the perforated well model, and the relation between the flow rate in the perforated hole, the fluid flow rate at the outer boundary of compacted zone as well as the productivity ratio and the perforated depth and density under the condition of perforated depth and under the condition that there are (or not) compacted zone and contamination by drilling operation is studied also in the paper. Through study, some new knowledges that there is non-permeability interval in the borehole and too high density of the perforations is inadvisable are obtained, providing a theoretical basis for the optimal design of perforated completion and the productivity prediction.

SUBJECT HEADINGS: Two dimension, Finite element method, Thermal Simulation, Perforated completion, Open hole completion, Research

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THREE DIMENSIONAL MECHANIC ANALYSIS OF THE TESTING STRING IN DEEP WELL WITH HIGH TEMPERATURE AND HIGH PRESSURE

Deng Xiong and Liang Zheng (Southwest Petroleum Institute) and Yu Xiaolin (Huabei Petroleum Administration). *NATUR. GAS IND.* v. 20, no. 4, pp. 54~ 57, 7/25/2000. (ISSN 1000-0976; **In Chinese**)

ABSTRACT: Along with the development of drilling works to deep reservoirs, more and more deep wells with high temperature and high pressure will be drilled. After seismic exploration, cuttings logging, coring and well logging, the deep well testing is the only method of directly understanding formation fluid char-