DOI:10.13639/j.odpt.2001.05.017

海上油田酸化酸液的选择及现场应用

张振峰 张士诚 单学军 蒋晓岚
(石油大学,北京昌平 102249) (华北石油管理局,河北任丘 062552)

摘要 针对海上油田地层疏松、孔隙度大、渗透率高、油层易出砂、完井多采用砾石充填等特点及造成地层污染的原因,采用低浓度复合酸作为酸化施工主处理液,这样既减少了对地层及充填砾石的损害,又保证了处理液对地层有适宜的、较高的溶蚀率,对解除钻井液和固井水泥浆造成的污染堵塞也有明显效果。海上油田酸化施工对环境保护有更高的要求,残酸需进一步处理,达到海洋环保标准要求后安全排放。经过酸液类型及浓度的确定、添加剂的筛选、流动模拟及残酸分析、处理等室内试验研究,确定了适用于海上酸化的酸液配方及泵注工艺,应用于渤海绥中 36—1 油田,取得了良好的酸化效果。

主题词 海上油气田 酸化 酸处理液 解堵 环境保护

作者简介 张振峰,1970 年生。1990 年毕业于江汉石油学院应用化学系,1998 年考入石油大学(北京)油气田开发专业,硕士,工程师。

酸化是油气田增产增注的一项重要措施,对于陆上油田,酸化已有了成功的经验;而海上油田酸化与陆上油田不同:首先由于地层疏松、孔隙度大、渗透率高,油层易出砂,完井多采用砾石充填,因此对酸液配方及工艺要求严格;其次平台面积小,设备不易摆放,现场施工难度大;第三对残酸的处理和排放要求严格。

基于这些原因,使海上酸化酸液的选择及现场施工工艺技术较陆上酸化有更高的要求。考虑到海上酸化这些特殊要求,研究出适用于海上酸化的酸液,并采用具有针对性的工艺技术,在渤海石油公司绥中 36—1 油田进行了试验,现场施工后收到了良好效果。

室内试验研究

以渤海绥中 36—1 油田为例,该油田地层岩心胶结疏松,平均孔隙度高达 32%,平均渗透率高达 $1700\times10^{-3}\mu m^2$,完井时采用了粒径为 0.45 ~ 0.28 mm 的砾石充填防砂,且原油粘度高,在 50℃条件下,粘度高达 1000mPa·s。经分析认为污油、固相颗粒侵入及地层出砂是造成地层污染的主要原因,因此,在确定海上油田酸化类型和浓度时应考虑以下问题:(1)破坏储层岩心骨架、防砂砾石,不损坏井下管柱;(2)能解除近井和较深部的地层污染堵塞;(3)

2 Agawal R G, Carter R D, Pollock C B. Evaluation and Performance Prediction of Low—Permeability Gas Wells Stimulated by Massive Hydraulic Fracturing. J. Pet. Tech., 1979, March: 362 ~ 372

3 Cinco H, Samaniego F, Dominguez N. Transient Pressure Behavoir for a Well with a Finite—Conductivity Vertical Fracture. Soc. Pet. Eng. J., 1978, Aug: 253 ~ 264

4 Cinco H, Samaniego F. Transient Pressure Analysis for Fractured Wells. J. Pet. Tech., 1981, September: 1749 ~ 1766

5 刘慈群. 在双重孔隙介质中有限导流垂直裂缝井的非牛顿流体试井分析方法. 石油学报, 1990, 11(4): 61 ~ 67

6 赵金洲, 任书泉. 考虑温度影响时裂缝几何尺寸的数值计算模型和方法. 石油学报, 1987, 8(1): 71 ~ 82

7 张平, 赵金洲, 郭大立, 陈汉斌, 田继东. 水力压裂裂缝三维延伸数值模拟研究. 石油钻采工艺, 1997, 19(3): 53 ~ 59

8 郭大立, 纪禄军, 赵金洲, 刘慈群. 煤层压裂裂缝三维延伸模拟及产量预测研究. 应用数学和力学, 2001, 22(4): 337 ~ 344

9 郭大立, 赵金洲, 吴刚, 李青山. 水力压裂优化设计方法研究. 西南石油学院学报, 2000, 21(4): 61 ~ 63

(收稿日期 2001-05-22)
〔编辑 付丽霞〕

稳定粘土,防止其膨胀和分散运移;(4)防乳、破乳、降低表面张力,并保持岩心水润湿;(5)稳定铁离子,防止二次沉淀的产生;(6)降低原油的粘度,并能清除地层孔隙喉道的胶质、沥青质污染物的堵塞;(7)残酸生物毒性小,经处理后能安全排放。

因此,海上酸化酸液的室内试验研究应包括酸液类型及浓度的确定、添加剂的筛选、流动模拟及残酸分析和处理试验。

一、酸液类型及浓度的确定

1. *砾石酸浸试验* 在确定酸液类型及浓度时,首先进行了砾石酸浸试验,然后将选出的酸液配方进行岩心、钻井液滤饼和固井水泥浆块的酸浸试验。

称取 2g 砾石,加入 20mL 酸液,在 60℃恒温 2h,取出过滤,用清水冲洗至中性,烘干称重,计算溶失率(见表 1)。

表 1 渤海绥中 36—1 油田砾石酸浸试验结果

酸液配方	浸前砾石量/g	浸后砾石量/g	溶蚀率/%
6%HCl	2.001	1.973	1.40
10%HCl	2.012	1.983	1.44
8%HCl+1%HF	2.005	1.907	4.89
6%HCl+0.5%HF+6%HBF_4+2%HAC	2.003	1.987	0.80
5%HBF_4	2.001	1.991	0.50
10%HBF_4	2.003	1.986	0.85

由表 1 可以看出:8%HCl+1%HF 对砾石溶蚀率高,破坏性大;其它配方像盐酸、氟硼酸、6%HCl+0.5%HF+6%HBF_4+2%HAC(复合酸)对砾石溶蚀率小。故渤海绥中 36—1 油田海上酸化不能采用陆上油田较常使用的常规土酸,而对盐酸、氟硼酸、复合酸还需做进一步筛选。

2. *岩心酸浸试验* 称取 5g 渤海绥中 36—1 油田 J6 井油砂岩心,加入 50mL 酸液,在 60℃恒温 2h,取出过滤,用清水冲洗至中性,烘干称重,计算溶失率(见表 2)。

表 2 酸对 J6 井油砂岩心溶蚀试验结果

酸液配方	溶蚀率/%
6%HCl	6.0
10%HCl	6.3
8%HCl+1%HF	7.9
6%HCl+0.5%HF+6%HBF_4+2%HAC	8.0

由表 2 可知:6%HCl 和 10%HCl 对 J6 井油砂岩心溶蚀率相差无几,复合酸和 8%HCl+1%HF 对 J6 井油砂岩心溶蚀率基本相同,因此酸化施工时可采用 6%HCl 作为前、后置酸液,而采用复合酸作为酸化施工主处理液。这样,既减少了对充填砾石的损害,又保证了处理液对岩心有适宜的、较高的溶蚀率。

由于油砂体表面有一层油膜,势必影响其溶蚀率,需用清洗液将油砂表面的油膜清洗干净后,再做溶蚀试验。结果表明:经过清洗液处理过的岩心油砂,溶蚀率可达到10.4%,可见,采用油层清洗液是必要的,它可清除附着油砂岩心表面上的粘油,解除岩心污油堵塞,同时提高酸液对岩心的溶蚀率。

3. *钻井液滤饼和固井水泥浆块的酸浸试验* 称取 2g 钻井液滤饼,加入 20mL 酸液;称取 3g 固井水泥,加入 30mL 酸液,在 60℃恒温 2h,取出过滤,用清水冲洗至中性,烘干称重,计算溶失率(见表 3)。

表 3 钻井液滤饼和固井水泥浆块的酸浸试验结果

酸液配方	钻井液滤饼溶蚀率/%	固井水泥浆块溶蚀率/%
6%HCl	48.9	29.8
6%HCl+0.5%HF+6%HBF_4+2%HAC	56.8	42.9

从表 3 可以看出,无论前、后置酸液还是处理酸液,对解除钻井液和固井水泥浆造成的污染堵塞都有明显效果。

二、添加剂的筛选试验

1. *缓蚀试验* 根据 SY5405—1996 缓蚀剂评价标准,在 90℃对 N—80 钢片进行 4h 试验(见表 4)。

表 4 缓蚀试验结果

序号	配方	钢片表面积/$10^{-4}m^2$	失量/g	腐蚀速度/$g\cdot(m^2\cdot h)^{-1}$
1	6%HCl+添加剂+3%CI11	13.082	0.0071	1.36
2	6%HCl+添加剂+3%LQ—3	12.748	0.0089	1.75
3	6%HCl+添加剂+3%LW—6	12.508	0.0080	1.60
4	6%HCl+0.5%HF+6%HBF_4+2%HAC+添加剂+3%CI11	12.326	0.0096	1.95
5	6%HCl+0.5%HF+6%HBF_4+2%HAC+添加剂+3%LQ—3	12.845	0.0094	1.88
6	6%HCl+0.5%HF+6%HBF_4+2%HAC+添加剂+3%LW—6	12.815	0.0090	1.76

从表4可看出:CI11、LQ－3、LW－6酸化缓蚀剂在渤海酸化配方液(前、后置酸液、处理液)中均具有较好的缓蚀效果,腐蚀速度低于部颁标准(SY5405－1996)。从酸液和试验后钢片表面观察可以得出:CI11缓蚀剂与其它酸液及其它添加剂配伍性能较好,因此,选用CI11缓蚀剂作为渤海绥中36－1油田酸化缓蚀剂。

2.粘土稳定剂筛选试验　绥中36－1油田J区岩心粘土含量高,平均含量12%(含蒙脱石10%)。这些粘土矿物遇水会发生水化膨胀、分散运移,堵塞孔喉、降低渗透率,严重地影响酸化效果。为此,酸液中必须优选粘土稳定剂,用来抑制粘土矿物的膨胀和运移。

称2g用不同防膨剂浸后岩心,加水800mL,在单臂搅拌机转速600~700r/min、常温下搅动2h,过0.5mm筛,烘干称量,计算溶失率(见表5)。

表5　粘土稳定剂筛选试验

粘土稳定剂	搅动前样量/g	搅动后样量/g	岩心溶失率/%
1.0%CS14	1.9094	1.7669	7.46
1.0%PTA	1.9133	1.7451	8.79
2.0%$ZrOCl_2$	1.8578	1.6157	13.03
0.5%溴化癸基吡啶	1.9532	1.7514	10.33
1.0%NH_4Cl	1.8736	0.6061	67.65
1.0%KCl	1.6623	0.5103	69.30

从表5可看出:CS14防膨剂稳定粘土的效果最好,易膨岩心用它浸泡后,溶失量小,再遇水不易膨胀,抗搅动能力强,比无机盐类、无机聚合物类、阳离子表面活性剂稳定粘土效果好。选用CS14作为渤海SZ36－1J区应用的粘土稳定剂。

3.表面活性剂筛选试验　表面活性剂不宜采用阴离子、阳离子表面活性剂,因阴离子表面活性剂与高矿化度地层水配伍性能不好,阳离子表面活性剂易造成砂岩油润湿,降低原油的渗透率。通常应用非离子表面活性剂。通过几种较好的表面活性剂的降表面张力、润湿性、洗油、破乳试验,综合比较可以得出:$OP_{扬}$、HD－3性能较好,适用于海上酸化酸液中表面活性剂的要求,可确定酸液基本配方为:

前、后置酸液:6%HCl＋3%CI11＋2%CS14＋0.3%$OP_{扬}$＋1.2%FE

处理酸液:6%HCl＋0.5%HF＋6%HBF_4＋2%HAC＋3%CI11＋2%CS14＋0.3%$OP_{扬}$＋1.2%FE

三、流动模拟试验

1.试验条件　试验温度60℃;岩心为J6井圆柱岩心,外包铅皮,两头包筛网;原油为由渤海石油公司提供的J区混合油;钻井液、堵漏液、射孔液由渤海石油公司提供。

2.试验程序　将岩心用J区混合原油饱和后进行试验。通液顺序为:正通4%NH_4Cl水溶液测渗透率k_1→分别反通钻井液、固井水泥浆、堵漏液、射孔液→正通4%NH_4Cl水溶液测k_2→反通3PV油层清洗液→反通2.5PV前置酸液→反通5PV处理酸液→反通2.5PV后置酸液→反通2PV油层保护液→关闸门反应40min→正通4%NH_4Cl水溶液测k_3,结果见表6。

表6　酸化解堵流动模拟试验结果

岩心编号	气测渗透率/$10^{-3}\mu m^2$	通液前k_1/$10^{-3}\mu m^2$	通液后k_2/$10^{-3}\mu m^2$	通酸后k_3/$10^{-3}\mu m^2$	$(k_2-k_1)/k_1$/%	$(k_3-k_2)/k_2$/%	$(k_3-k_1)/k_1$/%	所通液体类型
12	4063.6	485.5	17.8	167.0	－96.3	8.38	－65.6	钻井液
7	7358.2	1167	10.5	1436	－99.1	13 580	23	固井水泥浆
84	7754.5	1459	46	2830	－96.8	6051	94	堵漏液
5	6600.6	293	178	360	－39.0	102	23	射孔液

3.试验结果　从试验结果可看出:酸液对不同外来液体造成的地层堵塞,都有不同程度的解堵作用,且可提高由固井水泥浆、堵漏液、射孔液造成堵塞的岩心的渗透率。说明所确定酸液配方及泵注顺序正确、可靠,具有良好的酸化效果。

四、残酸分析及处理试验

1.海上酸化残酸处理方案　为保证酸化效果,酸后应及时排液。残酸由井底返排出后,虽有一定的酸液浓度,但由于酸液中仍保留有缓蚀剂,在较低温度下不会给地面管线及设备造成腐蚀,因此,残酸可通过测试分离器计量出排液流量后进入生产管线,此时利用平台化学剂注入系统加入0.5%~2%的缓蚀剂,在排残酸的同时,在生产管线加入清水或合格海水或开1口高含水井,使残酸与其它井的液

体进行混合,以便进一步降低管线残酸的浓度,混合液体的数量按照返排残酸流量的 25%加入。混合后的液体再进入海上水处理系统进一步处理,达到海洋环保防污染标准要求后安全排放。

2. 处理后残酸室内分析试验 用 CG-1A 型测汞仪,采用冷原子吸收法测定汞元素,含量小于0.4 mg/L;用 WFX-1F2B 原子吸收分光光度计,采用原子吸收分光光度法测定镉、铬元素,含量分别为 0.102mg/L、1.217mg/L;采用 4-氨基安替比林分光光度法(GB 7490-87)测定挥发酚,含量为 0.267mg/L;采用纳氏试剂比色法(GB7479-87)测定氨氮,含量为 6.01mg/L;重铬酸盐法测定化学需氧量为98.2 mg/L;生物毒性的测定方法采用以 GB/T15441-1995 为基础,结合石油工业特点的发光细菌法,EC_{50} 含量大于 10^4。采用标准为中华人民共和国污水综合排放标准 GB 8978-1996。

从检验结果可看出:残酸中检验的一类污染物各项指标都低于最高允许排放浓度,二类污染物指标低于现有二级排放标准。残酸的生物毒性级别为无毒。

现 场 应 用

根据渤海绥中 36-1J 区岩石物性和储层特征,通过大量室内试验,筛选、制定了施工所用的油层清洗液、前置酸液、处理酸液、后置酸液、油层保护液、顶替液配方及注入程序,即低替清洗液→正挤清洗液→正挤前置液→正挤主处理液→正挤后置液→正挤油层保护液→正挤顶替液。其中油层清洗液用量确定为 0.35m^3/m;前置液 0.4~0.6m^3/m;主处理液 0.8~1.2m^3/m;后置液 0.22m^3/m;油层保护液 0.2~0.4m^3/m。在挤酸结束后 1~1.5h,采用连续油管液氮返排残酸。

复合酸渤海绥中 36-1 油田应用 17 井次,酸化效果明显,日产油量都有所增加,效果较好的有 J5 井、J12 井、J10 井、J13 井、J3 井,日增油都达到 100t 以上,尤其是 J10 井,酸化前泵排量 70~125m^3/d,日产油 69.6t,酸化后泵排量增加到 200m^3/d,日产油为 212t;J11 井和 J6 井酸化前日产油都为 5t,酸化后日产油分别为 64t 和 86t,都达到了配产要求;J1 井、J7 井和 J15 井效果较差,但比酸前日产油量都有所增加。17 井次平均单井日增液量82.2t,平均单井日增油量为 77.1t,累计增油量为 1312t,经济效益和社会效益显著。

结 论

1. 海上油田由于地层疏松、孔隙度大、渗透率高,油层易出砂,完井多采用砾石充填,因此海上酸化不能采用陆上油田较常使用的常规土酸。通过对海上油田地层特点及造成地层污染原因的分析,采用低浓度复合酸作为酸化施工主处理液。这样,既减少了对充填砾石的损害,又保证了处理液对岩心有适宜的、较高的溶蚀率,对解除钻井液和固井水泥浆造成的污染堵塞也有明显效果。现场应用酸化效果显著。

2. 海上油田地层胶结疏松,粘土含量高,易发生水化膨胀、分散运移,堵塞孔喉、降低渗透率,因此,酸液中粘土稳定剂需具有良好的静态和动态的长期防膨效果。

3. 海上油田酸化施工对环境保护有更高的要求,残酸需进一步处理,使其中的一类污染物、二类污染物、生物毒性等各项指标达到海洋环保防污染标准要求后安全排放。

4. 海上油田酸化现场施工面积小,设备不易摆放。在钻井平台摆放设备、配制酸液、对采油平台上多口井进行交叉作业施工,是一种安全、可靠、经济的酸化作业方式。

参 考 文 献

1 沈燕来,刘德华,吉延章,陈建武. 渤海埕北绥中 36-1 油田注水井堵塞机理研究. 石油钻采工艺,1998,20(1):90~93

(收稿日期 2001-03-14)
(修改稿收到日期 2001-08-20)
〔编辑 郑秀娟〕

Subject heading aqueous material oil recovery light weight cement cement MTC technology water shutoff sand control

FLOWING MODEL ON VARIED STRESS NEARBY WELL IN LOW PERMEABILITY RESERVOIR

by Qin Jishun, Zhang Xinhong (University of Petroleum, East China)

Abstract An experimental study was carried out to determine the relations among rock permeability, porosity (compression coefficient) and effective stress, and to drive a state equation. The station equation can be used in setting up single well one dimensional two phase radial flow model whose boundary value problem can be worked out by a three dimensional two phase numerical model. By the flow principle in nearby well of low-permeability stratum under varied stress conditions can be further studied, and IPR curves of single well can also be plotted. It was also discussed that the radial flow model was used in interpreting oil field production data. Therefore, studying reservoir sensibility by experimental approach and computer models in doing with oil field production data were practicable and reasonable.

Subject heading low-permeability reservoir state equation elastoplasticity radial flow model IPR curves

FLOW OF POLY OUTPUT LIQUID IN ROD AND TUBE ANNUAR SPACE

by Zheng Junde (Research Institute of Petroleum Exploration and Development of China), Sun Zhi, Ren Gang, Miao Zhenbao

Abstract Laboratory testing showed that rheological property of polymer solution used in Daqing Oilfield agree with power-law mode. According to non-Newtonian fluid mechanics theory and mathematical method, and the plunger moving property taken into account, fluid velocity distribution, flow rate and pressure gradient equations were set up in the conditions concentric and eccentric of rod and tube annular space, and approximate solution were obtained. Calculating example showed that fluid velocity in rod and tube annular space changes steadily along with rod moving of up and down. In the condition of concentric of rod and tube, the stronger non-Newtonian property is, when $\theta=0$, the smaller n is, the larger dimensionless maximum velocity is; when $\theta=\pi$, the two dimensionless maximum velocities differ slightly in the condition of charging n.

Subject heading polymer power law fluid pumping well rod and tube annular flow property

REALIZATION AND APPLICATION OF THE MIXED INTELLIGENCE SYSTEM IN SCREENING OF VISCOUS CRUDE OIL PRODUCTION SCHEMES

by Sun Yanjun(Manage Branch of Hangzhou Electron and Industry Institute)

Abstract Traditionally the screening of viscous crude oil production schemes are conducted manually, in which every experts may arrive at different results and the superiority of these are hard to judge. The mixed intelligence system which is more reliable is put forward. In the system, the symbolic expert system (SBWS) and the artificial neural network are integrated, the former being aimed at optimizing the structure of the latter while the latter being used to acquire the contribution degrees of screening of viscous crude oil production schemes' character parameters. With the system, fuzzy expression of expert knowledge, multi-level organization of the knowledge base, fuzzy inference are realized. A satisfactory result was yielded in the field testing. The development of the system also opens a new perspective toward a more extensive utilization of the mixed intelligence system in other areas of oil exploration and development.

Subject heading mixing intelligence viscous crude oil recovery method sign expert system nerve network fuzzy inference

STUDY ON PRESSURE DISTRIBUTION IN FRACTURE DURING PRODUCING PROCESS

by Guo Dali, Zhao Jinzhou, Ji Lujun (Southwest Petroleum Institute)

Abstract According to the mechanics of gas and oil flow in reservoir after fracturing, a pressure distribution model during producing process has been established, which consider the variation of closure pressure and fracture conductivity, and includes flow equations of formation system, flow equation of fracture system, closure pressure equation and conductivity equation. Meanwhile these equations have been iteratively solved by Alternating Direction Method and Prediction-Correction Method. Based on those work, a set of software simulating pressure distribution in fracture has been developed, which can be used to guide and emend the fracturing design, and selection of treatment material and parameters.

Subject heading fracturing fracture pressure flow conductivity percolation

SELECTION AND APPLICATION OF ACID FLUID IN OFFSHORE FIELD

by Zhang Zhenfeng, Zhang Shicheng (University of Petroleum, Beijing), JiangXiaolan, Shan Xuejun

Abstract compound acid is used in accordance with the practical condition of pay zone at offshore Oilfield, such as high porosity and permeability, low bonding strength and gravel pacing. The compound acid has less damage and better suitable dissolving capacity to formation. It has remarkable effective on plug removing induced by drilling fluid and cement liquid too. According to demand of environment protection, there are many restrictions on acidizing at offshore

field. The spend acid should be disposed before it is discharged. The compound acid is developed after experiment of selecting the type and concentration of acid, selecting additives and analyzing spend acid. Field testing at offshore Oilfield SZ36-1 are successful.

Subject heading offshore field acidizing acidizing fluid plug removing environmental protection

RESEARCH OF SALT-RESISTING COLLOIDAL DISPERSION GELS

by Wu Jiazhong, Wang Zhengliang (Jianghan Petroleum Institute), Wang Zhiyong, Shi Bozhong

Abstract A new system of salt-resisting colloidal dispersion gels (CD gels) is researched and prepared. It contains nonionic polyacrylamide whose appropriate degree is from 800 mg/L to 1500 mg/L, acetic chromium whose appropriate degree is from 80 mg/L to 160 mg/L and formaldehyde whose degree is from 200 mg/L to 400 mg/L, etc. The CD gels have good salt-resisting and good water shutoff properties. Sixteen wells is efficacious within the eighteen field testing wells. Good effectiveness is acheved after field test.

Subject heading depth profile control colloidal dispersion gels salt tolerant property research field testing

TECHNOLOGY OF PREVENTION OIL STOLEN AND GAS CONTROL SYNERGY IN OIL PUMPING

by Huang Xuebin (No. 1 Production Plant, Zhongyuan Oilfield Co.), Chen Xuezhong, Tan Qingxian, Pan Weiguo, Dong Lixia, Jia Zonghua

Abstract In Wenliu Oilfield, the normal production of oil well was affected by oil stolen from casing, since the ratio of gas and oil is higher, the production fluid level is higher and the energy of oil well is more abundance. According to this problem, casing oil stolen prevention sealing valve was developed, matching with down-hole oil-gas separator and gas lift valve lift technology. After the gas-fluid has been separated by the downhole separator, the gas got into annular space of casing and tube. With the oil stolen prevention sealing valve, annular space was sealed, then the gas could get into tube when its pressure is high enough to open the gas lift valve, this made the pressure of tube-casing annular space balanced. Since field test effect is obvious, a new route was afforded to likely oilfield.

Subject heading oil pumping prevention air lock oil stolen gas lift valve application

APPLICATION OF SAND CONTROL TECHNOLOGY FILLED ONLY ONE TIME WITH PACK AND HIGH PRESSURE

by Wang Song, Chen Laiping, Chen Guang (Hekou Oil Production Plant, Shengli Oilfield Co.), Wang Heliang

Abstract To be filled in or out of the tube is the develop tendency of the sand control technology with gravel filled, so filled only one time with pack and high pressure dose. The principles, tool structure, and construction procedure were introduced, and the design method of the main parameters, such as discharge capacity, pressure were expounded. It was introduced that the technology has been used in old well with single or more beds, new wells, inclined wells and wells with siltstone. It has more advantages such as shorter construction period, longer sand control efficiency period, stranger applicability, and higher fluid production intensity. The higher integrate benefit of it has been obtained.

Subject heading pack high pressure sand control in or out of tube filling application

TECHNOLOGY OF PLUG REMOVAL INJECTION INCREASE WITH ECCENTRICITY SEPARATE LAYER WATER INJECTION HYDRAULIC SOUND WAVE

by Wu Hexiang, Song Bingzhong, Li Jiaming (Petroleum Engineering Academe, Henan Oilfield Co), Wang Kai

Abstract The research of technology of plug removal injection increase with eccentricity separate layer water injection hydraulic sound wave was developed according to the state and the problem of old Oilfield development. The technology principle and characteristic, the main technique parameters, and the field test were introduced. The structure and working law of the main matching tool PXSB-115-25/120 was narrated. Field application showed that this technology had some advantages such as simpleness technique, little investment, longer efficiency period.

Subject heading water injection well separate layer water injection sound wave plug removal injection increase research application

DEOXIDATION OF OILFIELD INJECTION WATER AND VACUUM SEPARATOR WITH CYCLONE WATER DEOXIDATION

by Zhang Xuewen, Zhang Yongxing (Chuankou Technique Research Institute of Petroluem), Li Danyan

Abstract The dissolution oxygen in injection water not only erode pipeline and water injection equipment, but also affect oilfield development effect, so a correlation criterion was made by CNPC. Every kind of deoxidize fashion in field water flooding were analyzed. The disadvantages of each fashion were pointed out. It was put forward to use vacuum separator with cyclone water deoxidation instead of existence equipment. The main work principium of this new technology was discussed in detail, and the advantages of it using in field water injection were analyzed.

Subject heading oil and gas fields water flooding deoxidation vacuum separator