Increasing the Life of Plunger Lift Equipment with BLAZE™ - Thermal Boron Diffusion

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Mechanical wear, corrosion and abrasion are production challenges that customers face during field operations.

Endurance Lift Solutions has partnered with B4C Technologies to introduce BLAZE™ technology to address these challenges.

BLAZE™ treated products have successfully achieved over 400% in run-life improvement over standard metallurgy.
BLAZE™ is a Thermal Boron Diffusion (TBD) process using a proprietary chemical formula to produce a slick, hard intermetallic ceramic Boride layer on metal surfaces.

Microscopic view of BLAZE™ treated surface with solid and uniform depth of .003 inches

**Low coefficient of friction**
Surface provides reduced coefficient of friction over base metal - permanent lubrication regardless of load

**Hardness**
1800-2300 Knoop
116 Rockwell C (extrapolated)

**Corrosion Resistance**
Corrosion resistance enables longer life in challenging downhole and surface conditions facing CO2 and H2S
Features

- Process creates no change in part dimensions/surfaces - is NOT a coating

- Intermetallic ceramic – no risk of bonding breakdown

- No increase in brittleness within the base metal

- Highly resistant to corrosion - impervious to hydrochloric and sulfuric acids

- Proprietary compound is environmentally safe - fully recyclable for a 100% “green” life cycle

**MATERIAL COMPATIBILITY**

- Cast Iron
- Mild-Carbon Steel
- Chrome-moly Steel
- Stainless Steel
- Inconel/Stellite
Value Creation

• Successfully trialed downhole plunger lift and surface valve equipment – demonstrated run life improvement up to 400%

• Enabled operators to reduce total lease operating expense - reduced routine equipment changes, product purchases and intervention equipment fees

• Decreased HSE risk due to fewer well-related interventions
Case Study – Plunger Lift

KEY FACTS

• Plunger lift is one of the most economical artificial lift methods in the market.

• Maintaining production and longevity of the plunger lift system is highly dependent upon how the mechanical components interact in the wellbore.

• Failure analysis of down-hole plunger lift components demonstrates how abrasion, corrosion and routine mechanical wear inhibit performance.
Endurance Lift Solutions (ELS) assessed various operating parameters of plunger lift systems in three (3) different customers’ wells where traditional variants of plungers were already deployed, such as:

- **Well Configurations/Conditions:** Vertical/Deviated, Highly Abrasive
- **Bumper spring seating depth of three (3) wells:**
  - 7,245 ft Avg; 7,370 ft Max; 7180 ft Min
- **Inclination on deviated wells:**
  - 42.5⁰ Avg; 44⁰ Max; 41⁰ Min.
- **Total # of cycles achieved by traditional plungers:**
  - Well #1: 1,500; Well #2: 1,400; Well #3: 800
- **MTBF on traditional plunger (run-days):**
  - Well #1: 52; Well #2: 56; Well #3: 57

Our assessment consisted of monitoring how BLAZE™-treated plungers wear over time when compared to traditional plungers.
Our team monitored the OD (outer diameter) of BLAZE™ plungers, and the number of cycles per system on a bi-weekly basis for wear.

Each plunger was measured against its initial plunger OD to determine if it was still running within max wear tolerance.

Figure 1: Well #1 - BLAZE™ plunger wear tolerance measurements up to 31 weeks.
RESULTS

**o BLAZE™ plunger cycles.**

Well #1: 5,547; Well #2: 4,903
Well #3: 1,188. *(POOH) DUE TO WELL ISSUES*

**o BLAZE™ plunger run-days per well.**

Well #1: 220; Well #2: 184
Well #3: 83 *(POOH) DUE TO WELL ISSUES*

The customer was able to significantly extend the run life of the plungers in these abrasive wells.
Partial evaluation of Well #1 concluded that:

- The BLAZE™ plunger cycled 4,047-times more than the best competitor.
- BLAZE™ plunger OD reduced from 1.9045” to 1.89” in 31 weeks which represents just 72.5% of maximum permissible wear.
- Representative BLAZE™ plunger had 220 days of run-time without the need for replacement.
Case Study – Plunger Lift cont.

Overall evaluation of three (3) wells concluded that:

- 3 out of 3 BLAZE™ plungers achieved better run time compared with traditional plungers
- Two (2) BLAZE™ plungers utilized for our analysis continued to operate and one (1) was POOH due to well production issues.

Overall, enhancing the life span of a plunger allowed the customer to obtain more benefits with the reliable BLAZE™ technology.
Case Study – Trim Kits

Endurance Lift Solutions (ELS) conducted a run-life comparison analysis between carbide and RF85 trim kits with BLAZETM-treated trim kits. Our assessment consisted of monitoring how BLAZETM-trim kits would operate when compared to traditional trim kits.

ELS tracked carbide and RF85 trim kit run-life, in order to compare to BLAZETM treated trim kits.

• MTBF on carbide treated trim kits (run-days):
  Well #1: 21; Well #2: 24; Well #3: 7

• MTBF on RF-85 treated trim kits (run-days):
  Well #2: 24
RESULTS of BLAZE™ treated trim kits

• MTBF on BLAZE™-treated trim kits (run-days).
  Well #1: 92; Well #2: 127

• MTBF on BLAZE™-treated trim kits (run-days). ROOS (REMOVED OUT OF SERVICE)
  Well #3: 39. However, it was ROOS prematurely.

The customer was able to significantly extend the run life of the trim kits in these highly abrasive wells.
Partial evaluation of Well #2 concluded that:

- The BLAZE™-treated 1” trim kit had 127 days of run life, 103 days more than traditional trim kits.
- The BLAZE™-treated 1” trim kits operated 400% longer than carbide/RF85 trim kits in certain applications.

Overall evaluation of three (3) wells concluded that:

- 3 out of 3 BLAZE™-treated 1” trim kits achieved better run life results than carbide/RF85 trim kits.
- 2 out of 3 BLAZE™-treated 1” trim kits utilized for our analysis continued to operate in the field while surpassing carbide/RF85 trim kit run life.
- 1 out of 3 BLAZE™-treated 1” trim kits was removed out of service prematurely. However, wear analysis concluded the kit had substantial remaining useful life.
Overall, enhancing the life span of trim kits allowed the customer to obtain more benefits with the highly reliable BLAZE™ technology.
Mechanical wear, corrosion and abrasion are production challenges that customers face during field operations - BLAZE™ technology addresses these challenges.

BLAZE™ treated products have successfully achieved over 400% in run-life improvement over standard metallurgy.

Endurance Lift Solutions currently offers multiple commercial products with BLAZE™ treatment.

New applications continue to be tested and deployed.
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