Pickling A Tubing String

Pickling a string prior to an acid job removes pipe dope, mud and cement debris, mill scale, mineral scales and corrosion byproducts. There are three steps: finding a pickle that will remove the damage, keeping the pickle off the formation and perfs and removing all that debris from the well. Pickle jobs with circulation are relatively easy. Pickle jobs done via bullheading are much harder. Much depends on the well type and the condition of the tubing. It also depends whether the tubing is a chrome alloy.

Circulation is possible (no packer, presence of J-nipple (side port) or sliding sleeve):
1. Set retrievable bridgeplug or inflatable plug above perfs
2. Establish circulation w/ water.(+ mutual solvent if oily, but watch the effect of mutual solvent on inhibitor – the mutual solvent reduces the inhibitor effectiveness since the mutual solvent excels at stripping oil and inhibitor films. Heritage Amoco work showed that to offset the effects of mutual solvent, you needed: about 20% more corrosion inhibitor, cut the contact time, and use the lowest strength acid possible to do the job (good advice in most cases when using acid) If tubulars are in poor shape, you may want to avoid acid and scour with a sand slurry)
3. Pump acid at 0.5 to 1 bpm
   New tubing: 200 to 300 gal (start at 5% 15% tubing volume?)
   Old tubing: 300 to 500 gal (start at 10% to 20% tube vol. depending on debris present)
   Heavily scaled: 500 to 700 gal
4. Displace w/ water until first 10% of acid is out of tubing
5. Reverse acid out of tubing at 0.5 to 1.0 bpm
6. Should initially return an acid between about 0.5% and a maximum of 3% HCl.
7. pH is not a good measurement to check acid strength. Even 0.2% acid strength has a pH lower than 1.
8. If HCl strength is more than 3%, reduce acid strength or acid volume in the next comparable job in the area.

No Circulation
Where circulation is not possible (bullhead pickling), the best source of data is SPE 73706 "Lessons Learned from Acid Pickle Treatments of Deep/Sour Gas Wells,". The authors discuss both circulation and bullheading pickle jobs. Some findings from the pickle jobs in general and the bullhead pickle jobs in particular:

1. Spent acid samples from deep, hot, sour gas wells contained up to 105,000 ppm iron in solution and suspension.
2. The components of the debris in these wells were pipe dope, mill scale, iron sulfides, sand and other fine particles.
3. The pickle fluids were selected from testing of dispersing and dissolving capacity on samples of dope and sludge.
4. Preflushes of solvent were found to acid the acid removal of the pipe dope.
5. The pipe dope (in this reference) removal could be tracked by the zinc iron concentration.
6. A mutual solvent was needed to strip oil from the iron scales – not the problems in the first section with mutual solvents and acid inhibitors.
7. In the bullhead pickle jobs, the acid was pumped to within 50ft of the top of the perfs and the formation pressure was used to flow the pickle back to the surface.

Shallower, onshore US pickle jobs have used a nitrogen preflush followed by the pickle acid, then blow it back before the acid hits the formation (this is not foolproof). Pickle pump rates must keep the liquids in turbulence to avoid separation of the gas. A large gas slug may be pumped in

some formations before the acid. Higher permeability formations (>20 md or naturally fractured formations) may leak off too much gas to recover the pickle.

Other Data

Iron contents: Usually from a sweet well, iron content in the acid is 1000 to 5000 ppm on the return. In a sour well, iron content can be 20,000+ ppm on the acid return. In an environment where oxygen is absent, iron will predominately be in the ferrous state and stale in solution to about a pH of 7, but if oxygen is introduced or if ferric iron is present from other sources (rust is the predominant source), then iron hydroxide can precipiate at a pH of about 1.8 to 2.2. (roughly 0.1% HCl remaining). Chelating agents, organic acids (pressure inhibited spending) and reducing agents are effective at preventing early iron precipiatation from solution, but the chemical process must be understood fully.

Comments:

1. All pickle jobs involving acid should have a properly selected and blended inhibitor. The inhibitor is NOT soluble in acid. It must be dispersed before pumping – gentle circulation methods will not work and care is needed in design of the circulating loop to make sure the top layer of the acid solution (i.e., the inhibitor), is actually pulled down and mixed.
2. An inhibitor will not stop the acid from reacting with iron corrosion, but it will slow the reaction with pipe
3. If an acid pickle is left too long in the pipe, the pipe will be attacked by the acid. Inhibitor effectiveness times shorten with increasing temperature and increasing acid concentration.
4. Sand slurry cleaning sweeps need to be pumped at turbulence.
5. Solvent cleaning sweeps must be compatible with other fluids and the seals in the system. Often spacers are necessary to prevent cross mixing and precipitates with active agents and flushes.
6. Scale converter systems such as EDTA, DPTA, sodiun hydroxide, etc., should not be over run with acid. Mixing acid with any of these materials will cancel the chelation ability of the dissolver or converter and can rapidly drop scale. Also – chemical converters and dissolvers take time to react, especially under pressure. Four to 12 hours may be required for significant reaction. Thin coatings of scale or other deposits are the best target for these materials.
7. Barium sulfate in its nearly pure state (90%+ $BaSO_4$) is not a good candidate for chemical dissolvers and mechanical action should be considered.
8. Oil coatings need to be removed to get the best acid reaction. Mulutal solvents may be useful, but they do increase the corrosion rate since they strip inhibitor films.
9. Wireline grease and pipe dope can usually not be chemically removed with standard solvents. Special solvent blends are usually effective if properly applied.
10. Extremely heavy loadings of scale or other deposits may berquire a mill cleanout.
11. Chrome pipe is extremely sensitive to acid – special inhibitors and inhibitor intensifiers are required. Remember - inhibitors are not acid soluble - just dispersible for a short period of time unless energy is continuously applied to the tank storage system.

With Coiled Tubing

The best acid placement is usually with coiled tubing where the CT can be pickled with an acid flush before entering the well. The tubing can be pickled with acid from the CT before the job if needed, but most times the CT is used to place the acid and lift the returns with gas lift. If CT is

picl=kled, be sure to flush the acid completely and store the CT with a nitrogen fill with ends capped with slip-on plastic covers.

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