EXAMPLE DESIGN CALCULATION

The design of an acid mutual solvent treatment for an oil well has the following characteristics;

Formation depth = 5,000ft; perforated interval (**hp**) = 10ft; **Kav** = 50md (Average formation permeability, including the damaged zone before acid treatment); Temperature = 150oF; **µo** = 1 cp at reservoir conditions; **µ** = 0.78 cp (viscosity of 15% HCL at 150oF from **Fig 1**); Initial fracture gradient (**gif**) = 0.7 psi/ft (at initial pressure (**Pi**) = 2,000psi), current reservoir pressure (**Pr**) = 1,000 psi; Overburden gradient (**gov**) = 1.0 psi/ft; Wellbore radius (**rw**) = 3 in., drainage radius (**re**) = 660ft. Calculate;

(a) The current fracture gradient (**gcf**)?

(b) The maximum acid injection rate ?

(c) The maximum surface pressure ()?

(d) The acid volume required to give 6-in. depth of permeability change?

(e) Estimate the appropriate acid design volumes for;

* Preflush stage
* Mud acid stage and
* Afterflush stage

**Solution**:

**Step 1:** To estimate the fracture gradient.

Using Pi = 2,000 psi; gif = 0.7 psi/ft; gov = 1 psi/ft and depth = 5,000ft. First, solve for the constant α in the equation at Pi;

Therefore solving for α, we have;

**α = 0.5**

**Secondly**, the current fracture gradient is estimated with **Pr** = 1,000 psi;

**Step 2:** To estimate the maximum injection rate.

Where, **Kav** = 50md; **hp** = 10ft; **gcf** = 0.6 psi/ft; **depth** = 5,000ft; **Pr** = 1,000 psi; **µ** = 0.78cp; **re** = 660 ft; **rw** = 3 in. = 3/12 ft = 0.25ft.

By dividing imax by the perforation interval (**hp**) = 10ft; we have

**0.08 bbl/min/ft**

**Step 3:** To estimate the maximum surface pressure ().

; **depth =** 5,000ft. **Acid hydrostatic gradient of 15% HCL ≈** 0.47 psi/ft using **Fig. 2**

**Step 4:** To estimate the acid volume required to give minimum of 6-in. depth of permeability change (x-axis). Note that 6-in. is selected since Kav = 50md > 5md. This is done using solution to step 2 or maximum injection rate per perforation = 0.08 bbl/min/ft (diagonals).

Use **Fig. 3** for 150oF to obtain acid volume by interpolation = **220 gal/ft of perforation interval.**

**Step 5:** To estimate the acid design volumes;

(i) For **Preflush** = 50 gal/ft × 10ft = 5**00 gal of 15% HCL**

(ii) For **Mud Acid** = 220 gal/ft × 10ft = **2,200gal of 3% HF + 12% HCL**

(iii) For **Afterflush** = 220 gal/ft × 10ft = **2,200gal of 90% diesel oil + 10% EGMBE**

**FIG. 1: ACID VISCOSITY CHART**

**FIG. 2: ACID HYDROSTATIC GRADIENT CHART**

**FIG. 3: Volume of Mud Acid with Injection Rates Chart @ 1500F**