Fluid Loss Data for WelDril's SuprSeal™ Product on a 3mm x 38mm Fracture

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INTRODUCTION

A fluid loss study was conducted with Wel Dril's SuprSeal product to determine if the slurried fluid would bridge on a 3 mm gap to simulate a fracture. The gap was formed using an API (American Petroleum Institute) conductivity cell that is typically used to simulate hydraulic fractures. In this case the cell was used to simulate an open fracture by not placing proppant material within the open gap. The material was squeezed against the artificial fracture using hydraulic pressure. The exiting fluid volumes were recorded for several squeeze pressures. The fluid loss volumes were recorded and converted to field volumes.

LABORATORY PROCEDURE

An API conductivity cell was prepared with two Ohio sandstone rock slabs approximately 1 cm thick. The slabs were roughened on a shaper/grinder to give texture to the surface. The width between the slabs was set with spacers to 3 mm and verified with feeler gauge. This gives a fracture of 3.81 cm width x 17.8 cm long and 3 mm wide. An open "frac" end is used on the squeeze side of the API cell to not restrict flow of the material to the gap. Full open ball valves were also used in the flow path. The cell was then mounted in a Carver hydraulic press laid on its side. The press holds the gap width and prevents its expansion when pressure is applied. See Figure A for a diagram.

The test is started by measuring the flow capacity of the gap by flowing upward through the gap at 100 ml/min with 2% KCl. The pressure required to flow at this rate is recorded and the flow capacity (rate (Q) over pressure (P)) calculated. Flow is diverted through the Ohio sandstone slabs one at a time and the flow capacity of each determined as well at a lower flow rate of 1 ml/min.

The SuprSeal material is prepared by mixing at 60 ppb in 2% KCl brine. A Hamilton Beach malt mixer was used to prepare the material and mix to a uniform slurry. The slurry was placed in a displacement cylinder attached to the ball valve assembly and the frac head. The valve and frac head were then purged with the SuprSeal slurry such that the material would be at the gap position when the test was started. The frac head was then attached to the test cell.

Fluid loss was monitored out of the fluid loss ports giving total fluid loss volume through both rock slabs and through the gap. Fluid loss volumes were recorded electronically with balances while recording the applied pressure. Pressure was held in increasing increments and held at each increment for 30 minutes while monitoring fluid loss.

Following pressure application, the displacement cylinder was removed and 2% KCl brine flowed vertically to determine the flow capacity of the gap. Once a stable flowing pressure was obtained, flow was redirected through each rock slab and the flow capacity of each measured.

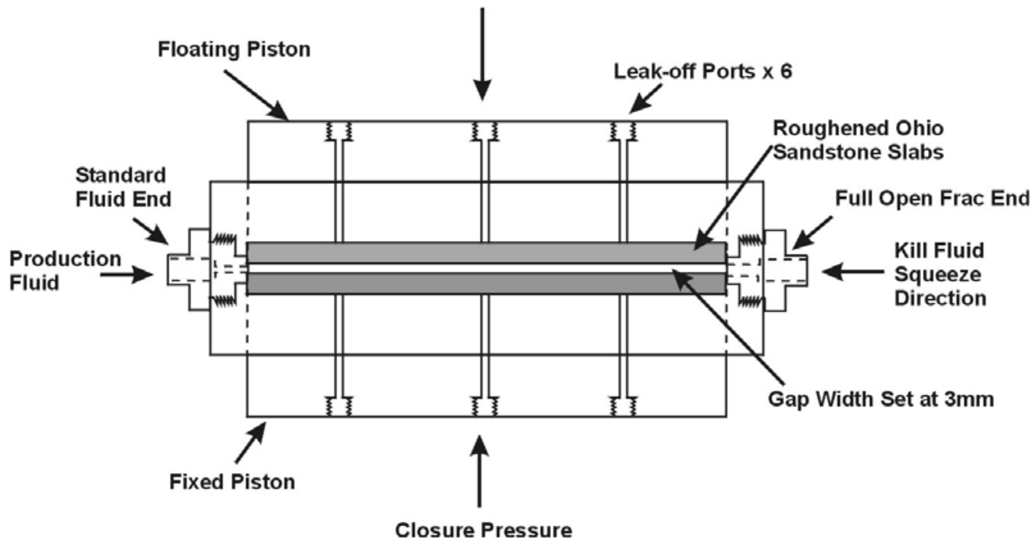
At the completion of the test, the API cell was disassembled and the internal volume of the fracture inspected to determine the amount of invasion of the material. Photos were taken for documentation.

DISCUSSION OF RESULTS

Flow capacity of the fracture and fracture faces (rock slabs) are summarized in table 1 for the initial measurements with nothing in the fracture, during squeeze of the SuprSeal slurry and the final. Figure 1 gives the fluid loss volume plotted as a typical fluid loss curve of volume versus square root of time. The fluid loss data was converted from lab units on the left y axis to typical wellbore volumes on the right y axis in gallons per foot of wellbore. This assumes the wellbore transverses parallel through a natural fracture of the same average width (fracture gaps opposite to one another in the wellbore). Data shows that fluid loss was nearly completely controlled at 100 psi. At subsequently higher pressures of 150, 200, 500 and 1000 psi, the fluid loss was restricted considerably as noted by the very low flow capacity values. No solids were observed exiting the fracture during this time, only liquid. No fluid loss was observed through the frac faces during the squeeze. This would indicate that the majority of the pressure drop was across the entrance to the fracture and not distributed down the length of the fracture.

Flow capacity following the fluid loss exposure showed reduced flow capacity through both the fracture and the fracture faces. However, when the cell was disassembled there was very little material observed in the fracture as shown in photo 1. The majority of the SuprSeal material was found packed above the fracture opening in the frac head, ball valve and into the displacement cylinder as shown in photo 2. This shows that the SuprSeal material was successful in bridging on the 3 mm gap and did not penetrate into the fracture.

Figure A
Experimental Setup – API Conductivity Cell



Experimental Setup – Flow Diagram

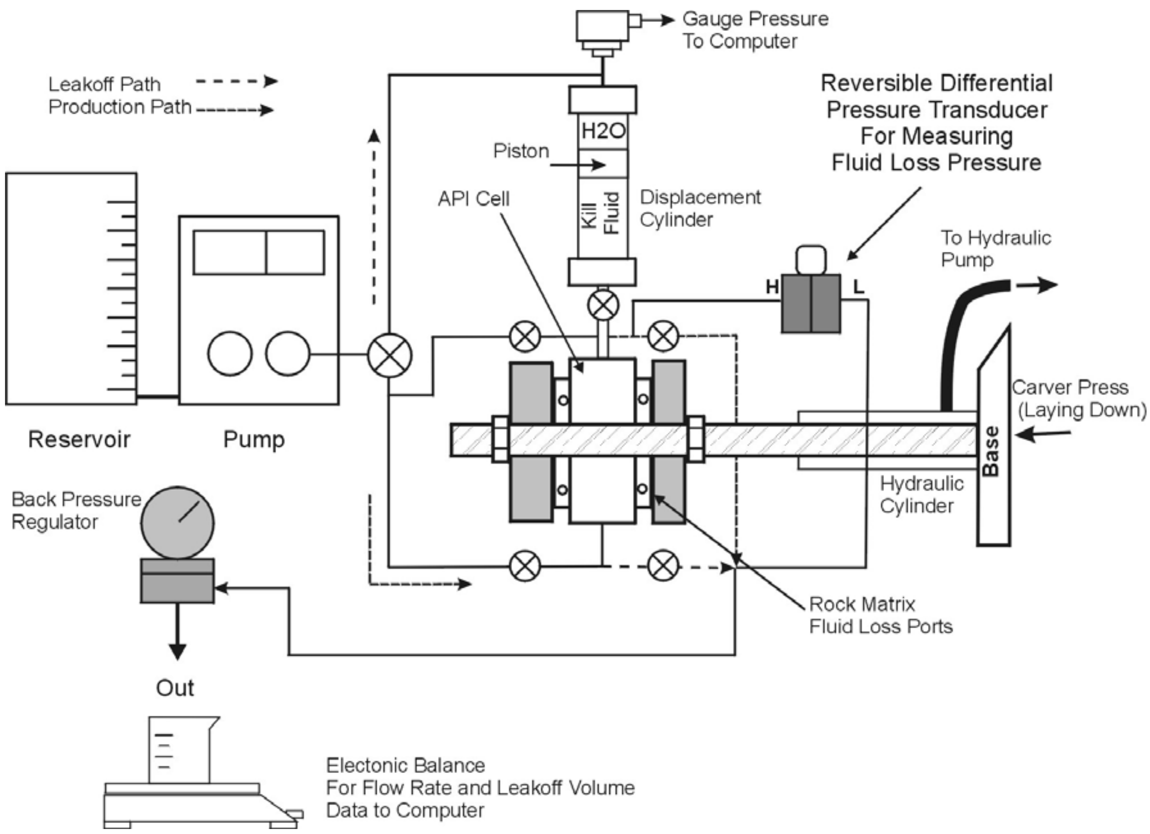


Table 1
Flow Capacity Q/P
For Fracture Faces and Fracture Opening

		Frac Face A	Frac Face B	Fracture
	Initial	10.1	9.01	4000
Squeeze	100 psi	0		0.0066
	150 psi	0		0.0167
	200 psi	0		0.0129
	500 psi	0		0.0089
	1000 psi	0		0.013
	Final	0.025	1.15	115.3

Figure 1
Fluid Loss and Pressure Response for Supr Seal on 3 mm x 38.1 mm Gap

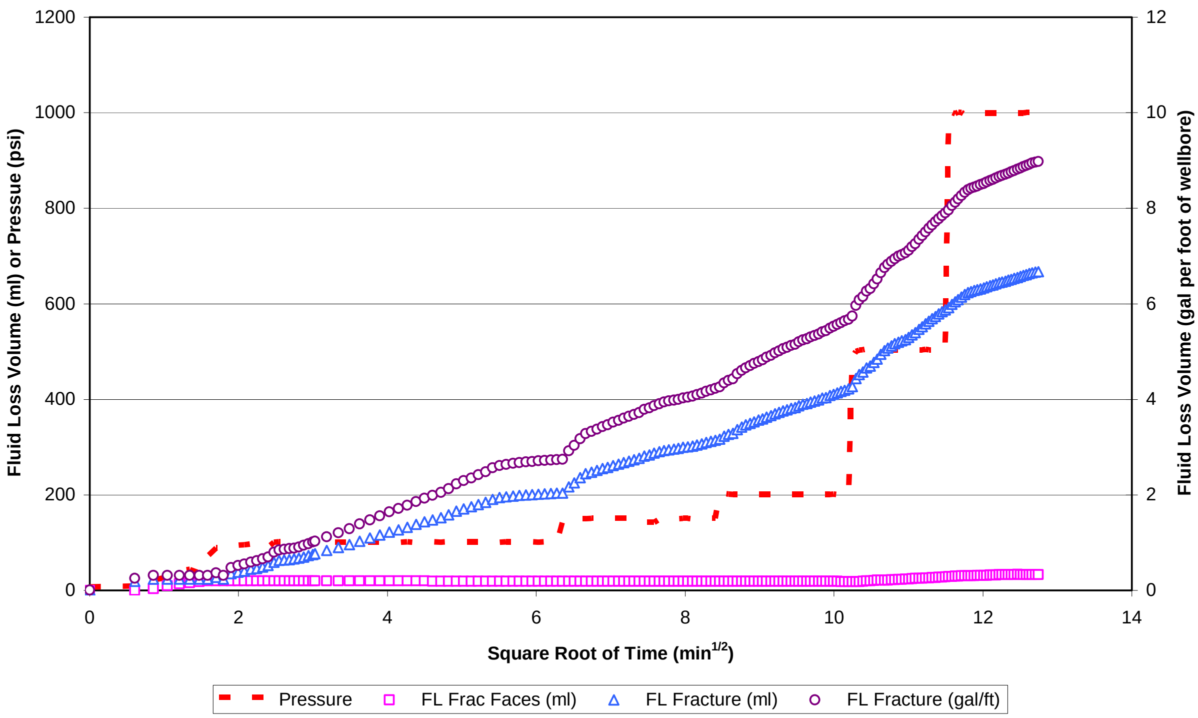


Photo 1
Core Slabs Following Test

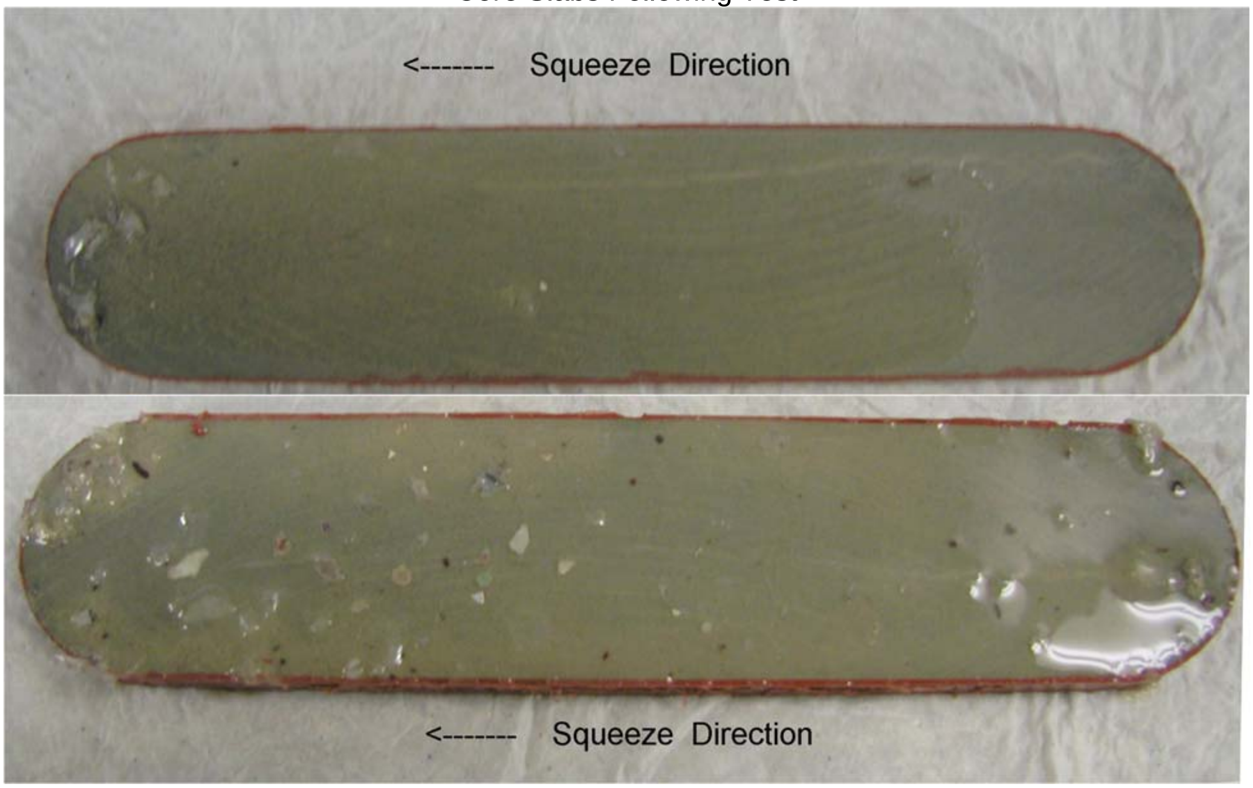


Photo 2
Displacement Cylinder Following Test