Possible Explanations for Evolution Effect

Contact Quantity

1. Plastic flow (or crack growth) increasing area of adhesive junctions

Contact Quality

2. Gradual removal of contaminants allowing stronger adhesion

3. Polymerization or other chemical reactions to increase adhesive strength

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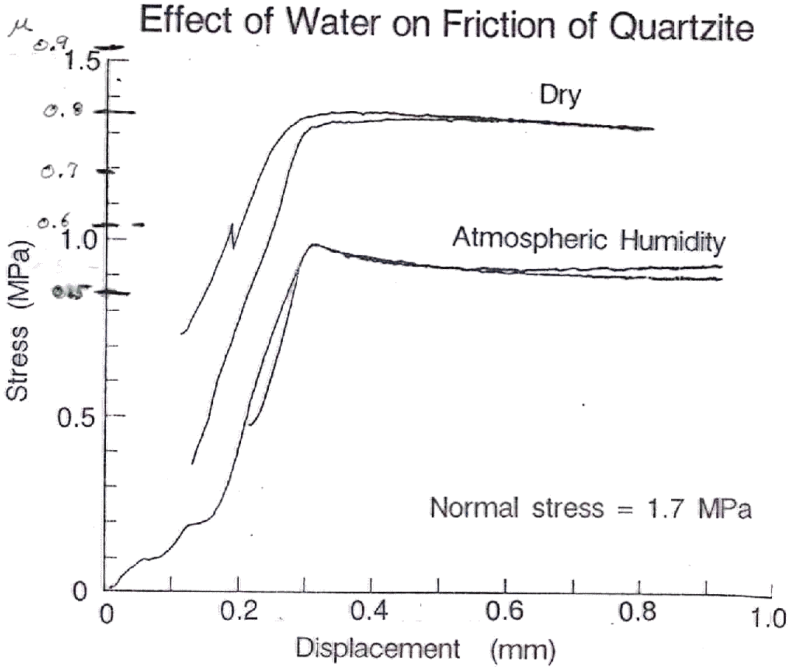
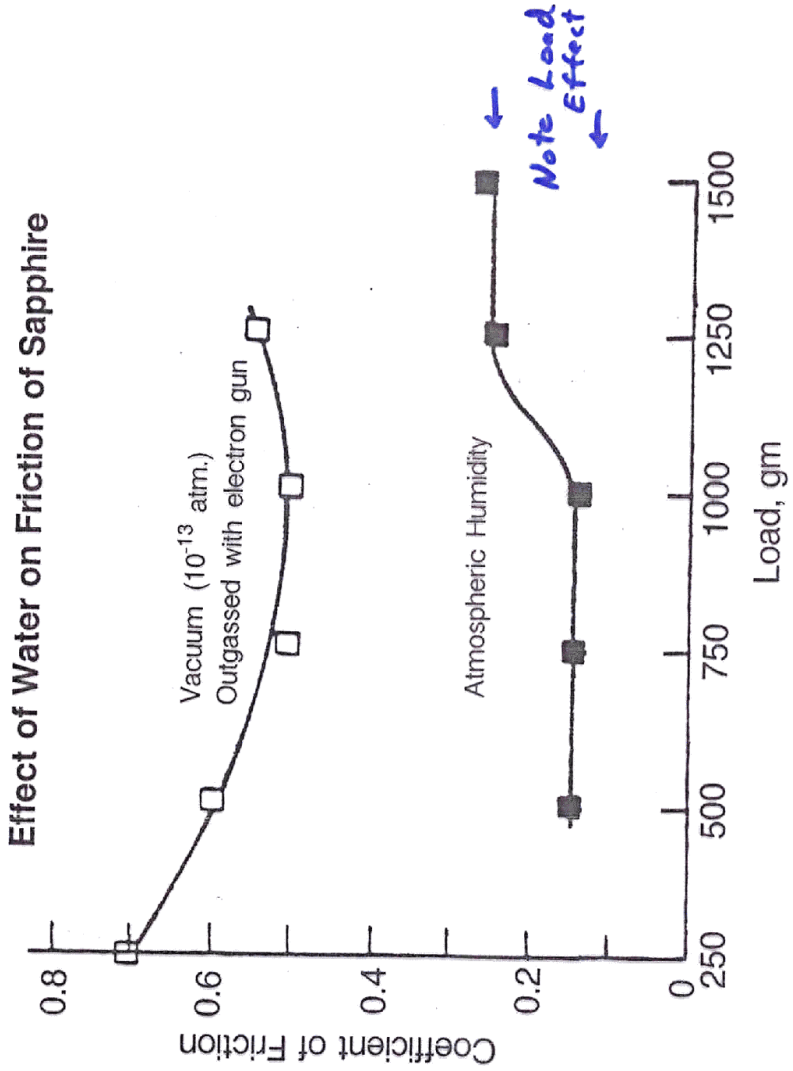


Dieterich & Conrad (1984)



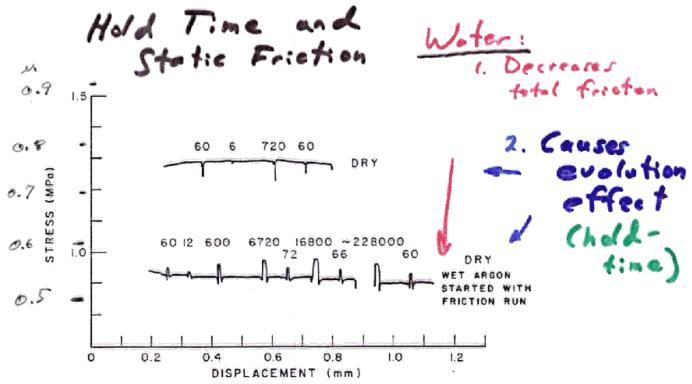


Fig. 6. Time dependence tests for dry samples of Eureka quartzite and for samples reexposed to humid argon during test. Driving velocity between hold intervals is 1.0 μm/s. Hold intervals, in seconds, is given above the curves. Normal stress is 1.7 MPa.

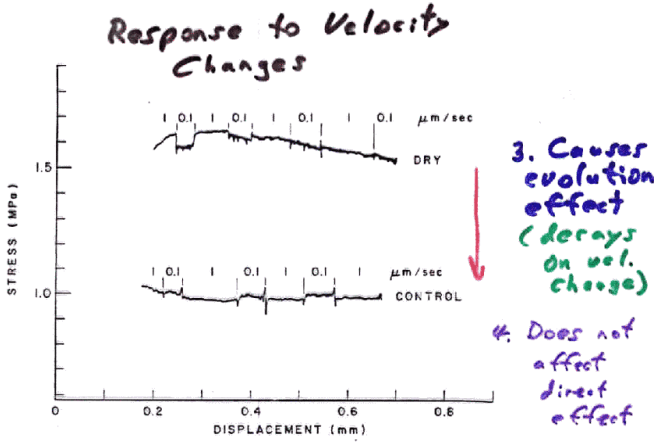
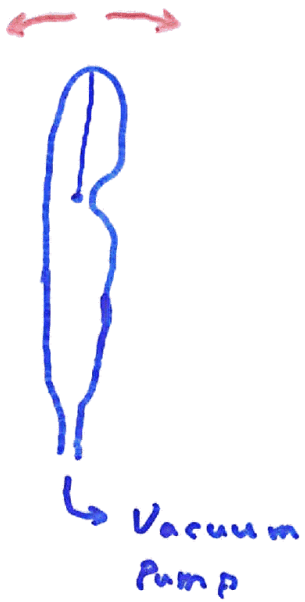
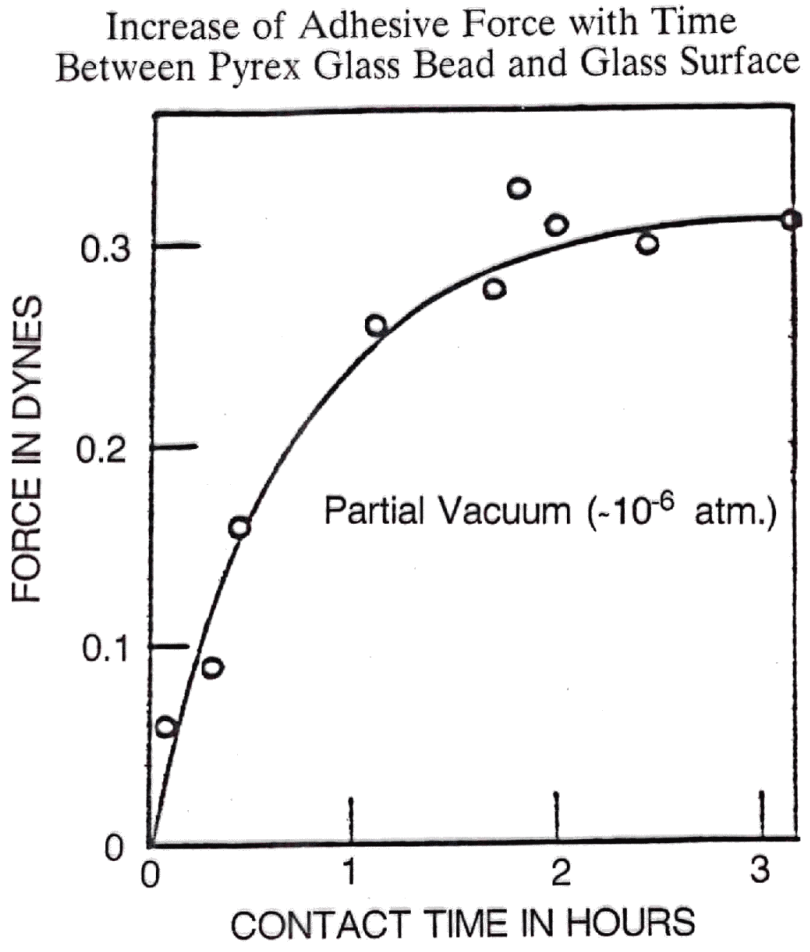


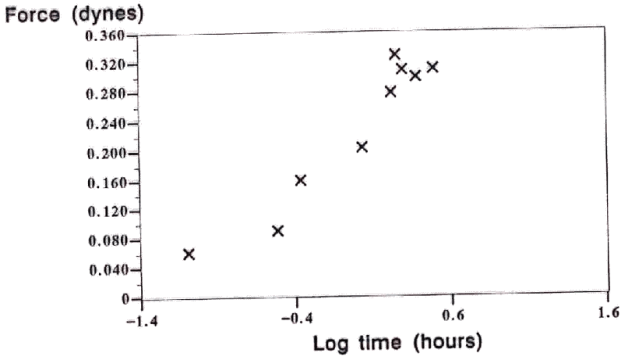
Fig. 8. Velocity stepping experiments for control experiment and dried samples in dry argon. Eureka quartzite at 1.7-MPa normal stress.

Dieterich & Conrad (1984)

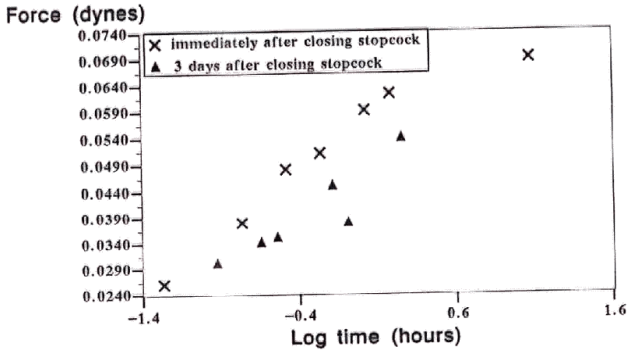

Vacuum
Pump


Increase of Adhesive Force with Time
Between Pyrex Glass Bead and Glass Surface
FORCE IN DYNES
0.3
0.2
0.1
0
Partial Vacuum (~10-6 atm.)
0
1
2
3
CONTACT TIME IN HOURS

Adhesion Strength of Pyrex Glass in Vacuum of 10^{-3} mm Hg



Adhesion Strength of Pyrex Glass in 1 mm Hg of Dry Nitrogen



Virgin glass ≈ 2.5 J m^{-2}
Healed at ≥ 120°C = 2.2 J m^{-2} } in air

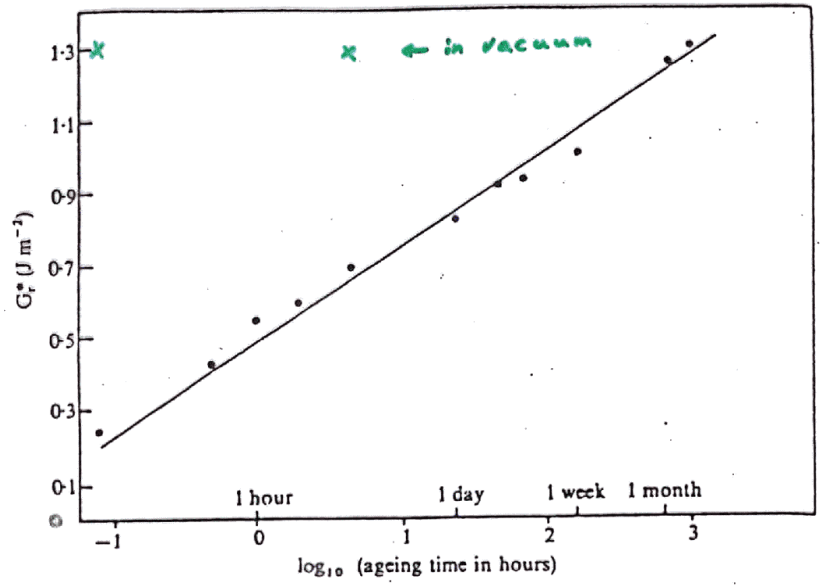
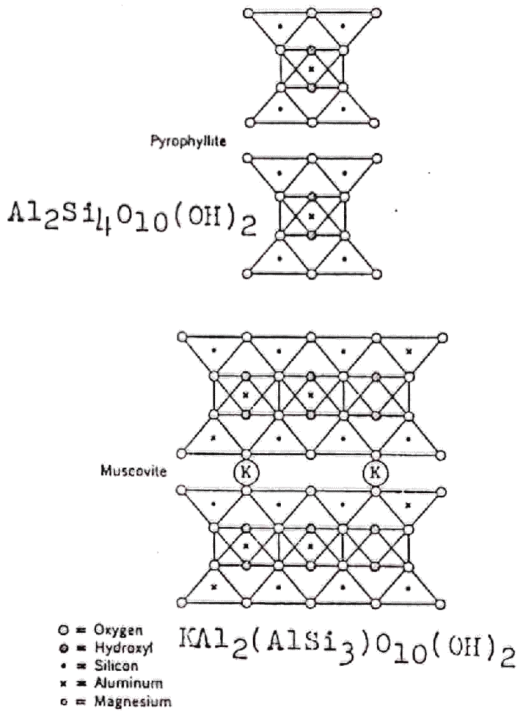


Figure 3. *Effect of the age of a closed crack in soda–lime–silica glass on the strain energy release rate required to repropagate it at 10^{-7} m s^{-1}. Crack closure, ageing, and repropagation all in air at room temperature*

Stavrinidis, B. & Holloway, D. G., Crack healing in glass, Phys. & Chem. of Glasses, 24, 19–25, 1983.



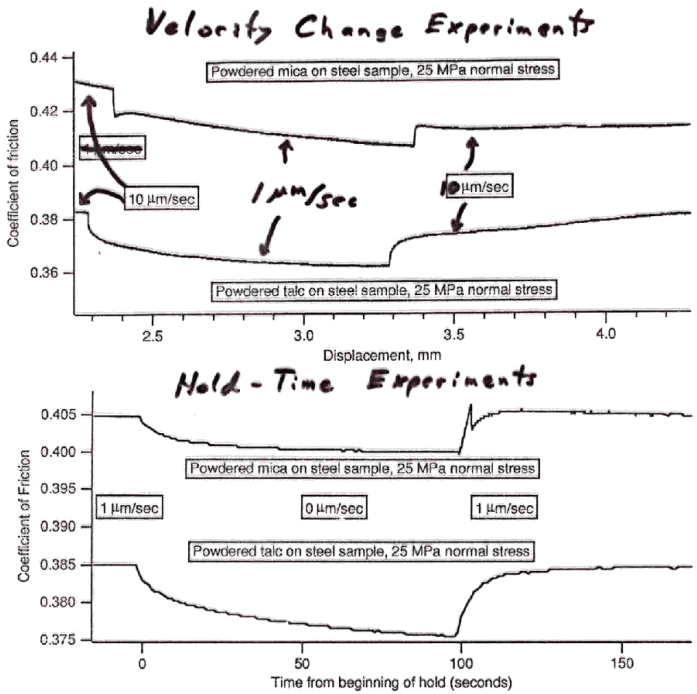
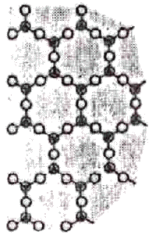


Figure 1. Comparison of response of talc and flourophlogopite mica to a velocity change (a) and stationary hold (b). Part a) shows frictional strength for a portion of an experiment in each material in which the sample was slid at 1 µm/sec, followed by an increase in sliding velocity to 10 µm/sec, followed in turn by a decrease to 1 µm/sec. The talc shows a response to the change that is quite rounded and has no hint of a transient peak, as would be expected from a material showing only the direct effect interacting with a compliant loading apparatus. While the mica does not show strongly the classical transient peak followed by decay, it is definitely present. Also, the corner is much sharper than for talc, a further indication of the action of an evolution effect. Part b) shows the response to re-loading following a period of zero loading velocity (100 seconds in this case). The presence of an evolution effect in the mica and absence of it in talc is shown even more convincingly here. The figure shows the steady-state frictional strength achieved at 1 µm/sec sliding rate at the beginning, followed by 100 seconds during which the loading rate was zero and the load decayed due to relaxation of the machine compliance, and finally a resumption of sliding at 1 µm/sec. Upon resumption of sliding, if an evolution effect is operating, the frictional strength is expected to rise to a higher level than the steady-state value, forming a transient peak. This occurs for mica as is shown in the top trace, for which a stick slip event followed the peak. The total absence of any such peak in the lower trace shows that the evolution is absent in the case of talc. The evolution effect is also responsible for the relatively flat-bottomed relaxation of the mica compared with the continuing decay of the talc.

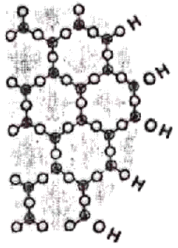
Interaction of Water with Quartz Surfaces

from Parks (1984)

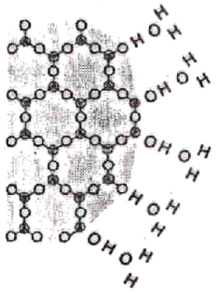
I. FRESH FRACTURE



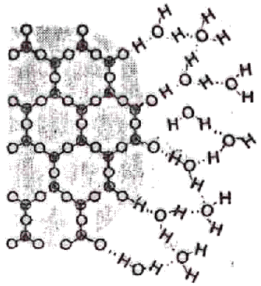
II. HYDROXYLATED

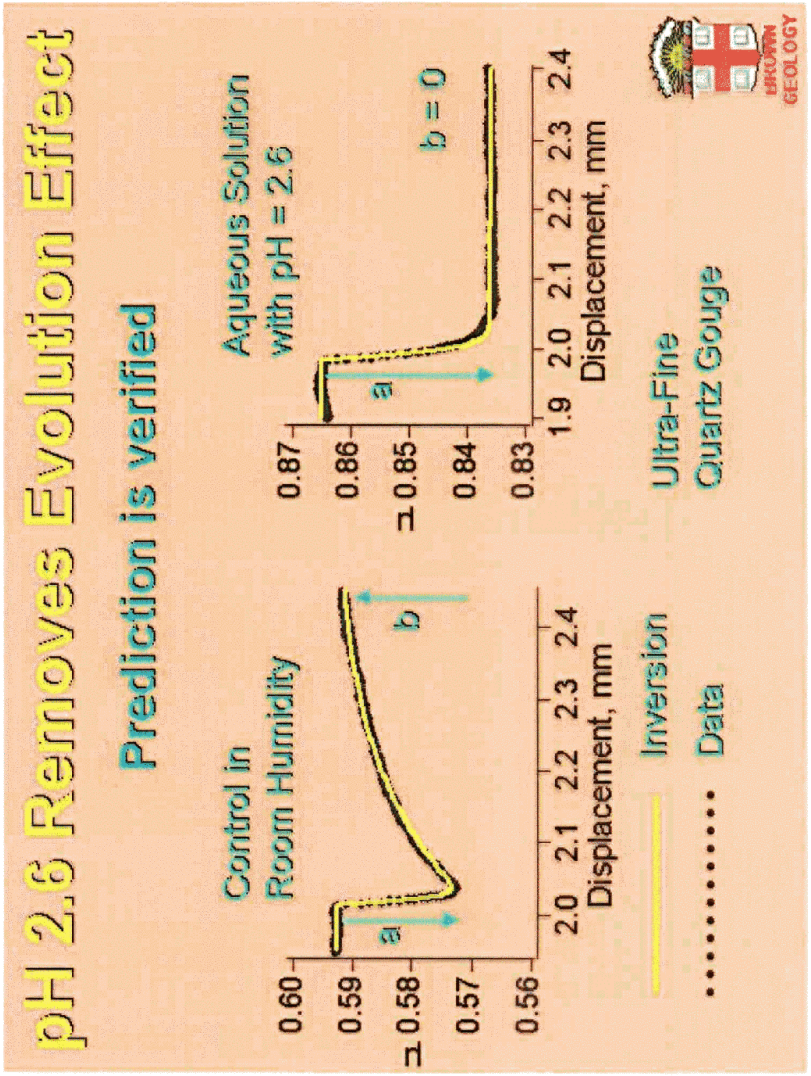


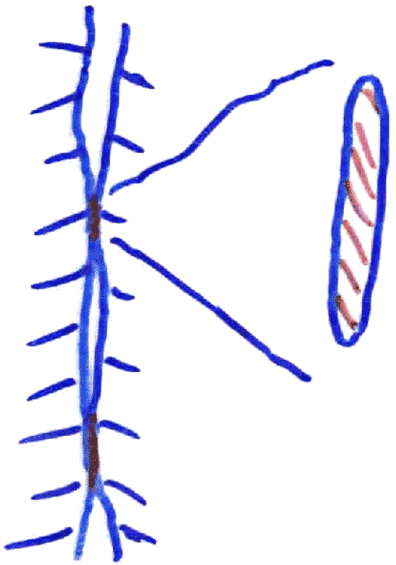
III. ADSORBED MOLECULAR WATER

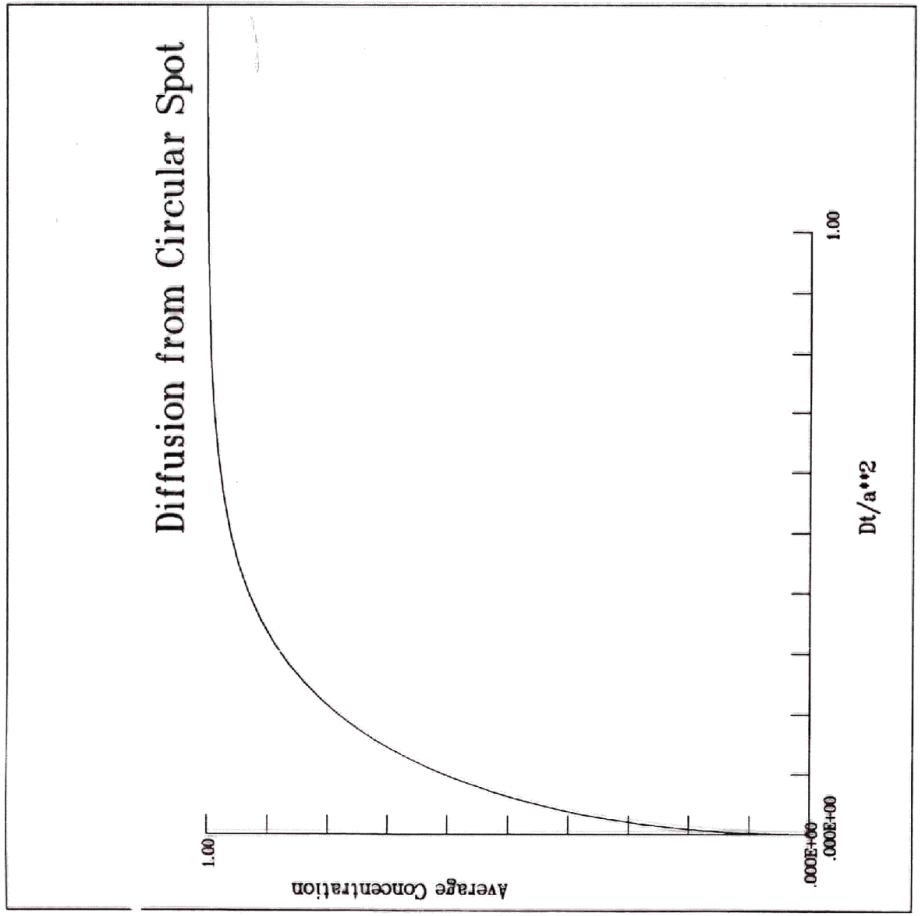


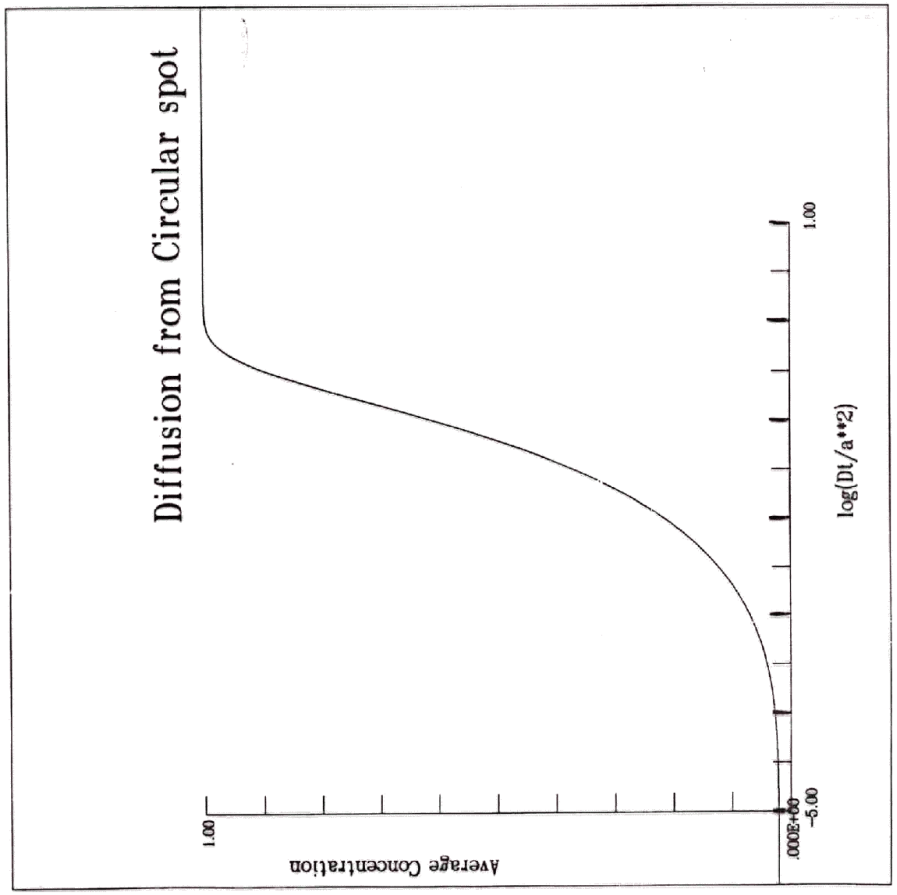
IV. WET SURFACE

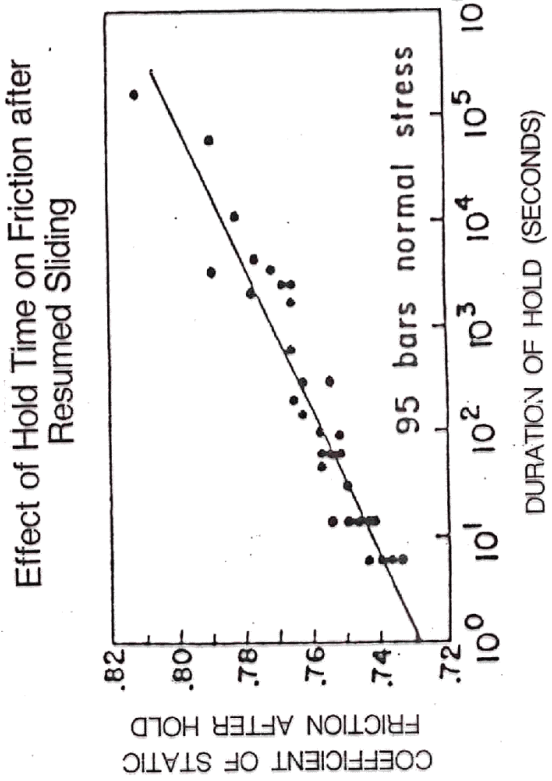







Diffusion from Circular Spot
Average Concentration
1.00
.00E+0000
.00E+3000
1.00
Dt/a**2


Diffusion from Circular spot
Average Concentration
1.00
.000E+00
-6.00
1.00
log(Dt/a**2)


Effect of Hold Time on Friction after Resumed Sliding
95 bars normal stress
COEFFICIENT OF STATIC FRICTION AFTER HOLD
.82
.80
.78
.76
.74
.72
10^0
10^1
10^2
10^3
10^4
10^5
10^6
DURATION OF HOLD (SECONDS)