Compression Calculations for Tuff-N-Nuff Pipe Wrap

Given: A_p = Cross sectional area of pipe wall
A_f = Cross sectional area for fluid transport

Assuming: Density of Steel = 0.278 lb/in^3
Density of Fluid = 0.036 lb/in^3 (Specific Gravity = 1)
Length of Pipe = 1 inch

Then: $V_p = A_p$ and $V_f = A_f$
And $WT_p = 0.278A_p$ and $WT_f = 0.036A_f$

$$A_p = \frac{\pi}{4}(d_o^2 - d_i^2)$$

$$A_f = \frac{\pi}{4}(d_i^2)$$

$$WT_p = (0.278)A_p = (0.278)\left(\frac{\pi}{4}\right)(d_o^2 - d_i^2) = (0.218)(d_o^2 - d_i^2)$$

$$WT_f = (0.036)A_f = (0.036)\left(\frac{\pi}{4}\right)(d_i^2) = (0.028)(d_i^2)$$

Let the total weight equal 50 lbs. This load strains the Tuff-N-Nuff material to about 50%.

Then:

$$WT_p + WT_f = 50$$

$$(0.218)(d_o^2 - d_i^2) + (0.028)(d_i^2) = 50$$

$$0.218d_o^2 - 0.218d_i^2 + 0.028d_i^2 = 50$$

$$0.218d_o^2 - 0.190d_i^2 = 50$$

Assume ½" wall thickness:
Then:

$$d_o = d_i + 1$$

and

$$0.218(d_i + 1)^2 - 0.190(d_i)^2 = 50$$

$$0.218(d_i^2 + 2d_i + 1) - 0.190(d_i) = 50$$

$$0.028d_i^2 + 0.436d_i - 49.78 = 0$$

Then

$$a = 0.028$$

$$b = 0.436$$

$$c = -49.78$$

$$d_i = \left[\frac{-0.436 + \left(\sqrt{0.436^2 - (4)(0.028)(-49.78)}\right)}{(2)(0.028)}\right]$$

$$d_i = 35$$

$$d_o = d_i + 1 = 36$$

Summary:

A 36" outside diameter pipe, with a ½" wall thickness, carrying a fluid with a specific gravity of 1, would compress the Tuff-N-Nuff pipe wrap 50%. Variations to wall thickness, pipe diameters, and specific gravity of the transported fluid would alter the compression of the Tuff-N-Nuff.