

4.2. BELLOWS HYDROFORMING FOR MATERIAL WITH DIFFERENT PROPERTIES

4.2.1. STRESS ANALYSIS IN BELLOWS

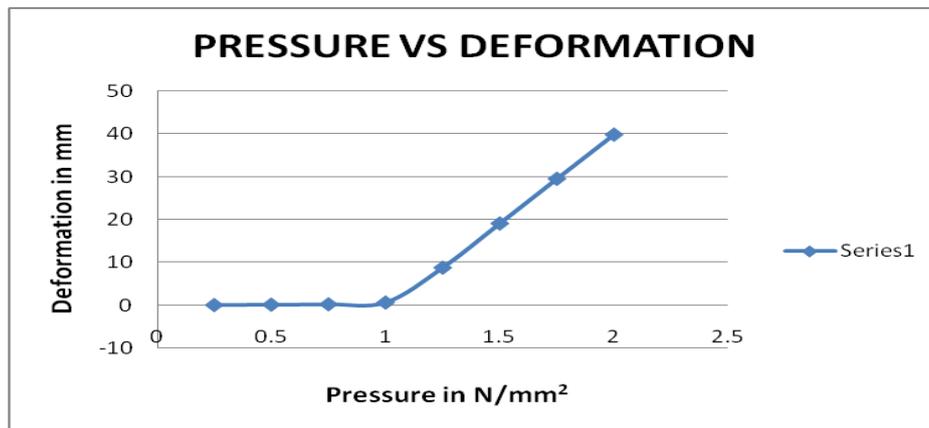
The following material and geometry properties are used.

Material Name	Young's Modulus	Poisson's Ratio	Yield Stress	Tangent Modulus	Internal Diameter	Thickness	Height
316L Stainless Steel	1.93e5 N/mm ²	0.3	290 N/mm ²	2000, 1500, 1000, 500 N/mm ²	400 mm	0.6 mm	400 mm

The cylindrical bellows are designed using ANSYS and analysed the same at different tangential modulus in the range of 2000 N/mm², 1500 N/mm², 1000 N/mm² and 500 N/mm².

The bellows are designed and analysis was done with internal pressure values vary from 0.25 N/mm² to 2 N/mm² in the interval of 0.25 N/mm² and the results are plotted as follows.

(a) Deformation in Cylindrical Pipe at Various Pressures



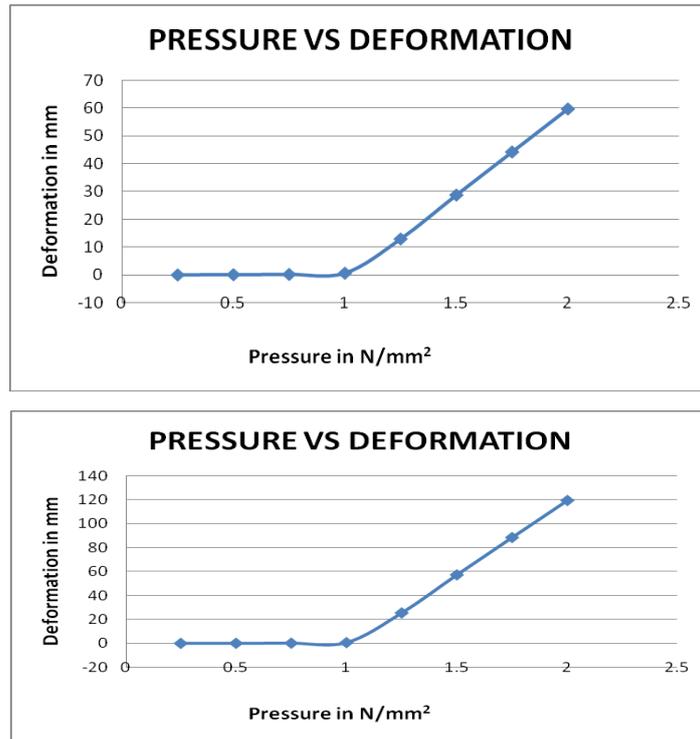


Figure 10: Shows the effect of pressure on deformation in bellow at (a) tangential modulus is 1500 N/mm² (b) tangential modulus is 1000 N/mm² (c) tangential modulus is 500 N/mm²

Figure 10 shows the effect of pressure on deformation in cylindrical bellows at different tangential modulus such as 1500 N/mm², 1000 N/mm² and 500 N/mm² and the deformation is constant upto certain pressures and increases as increases the pressure and the deformation varies with tangential modulus as shown in above figure, varies from 40 mm to 120 mm at pressure 2 N/mm² for different tangential modulus values same can be observed in figure 11.

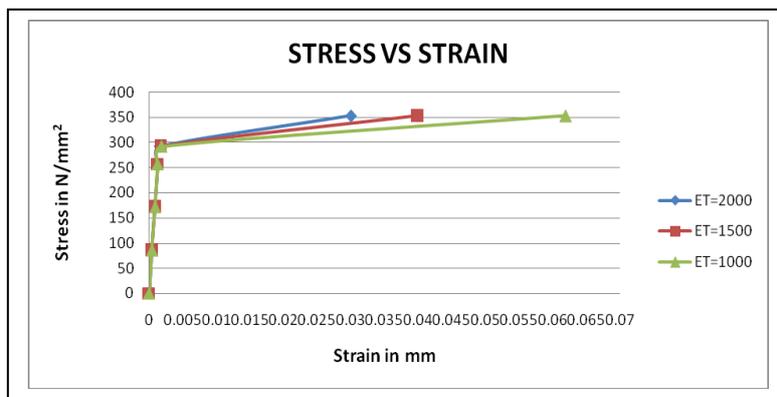


Figure 11: Shows the strain in the bellows at different stress of the tangential modulus.

(b) Plastic Strain in Bellows at Various Pressures

Figure 17 shows the effect of pressure on plastic strain in bellow at the tangential modulus is 1500 N/mm^2 .

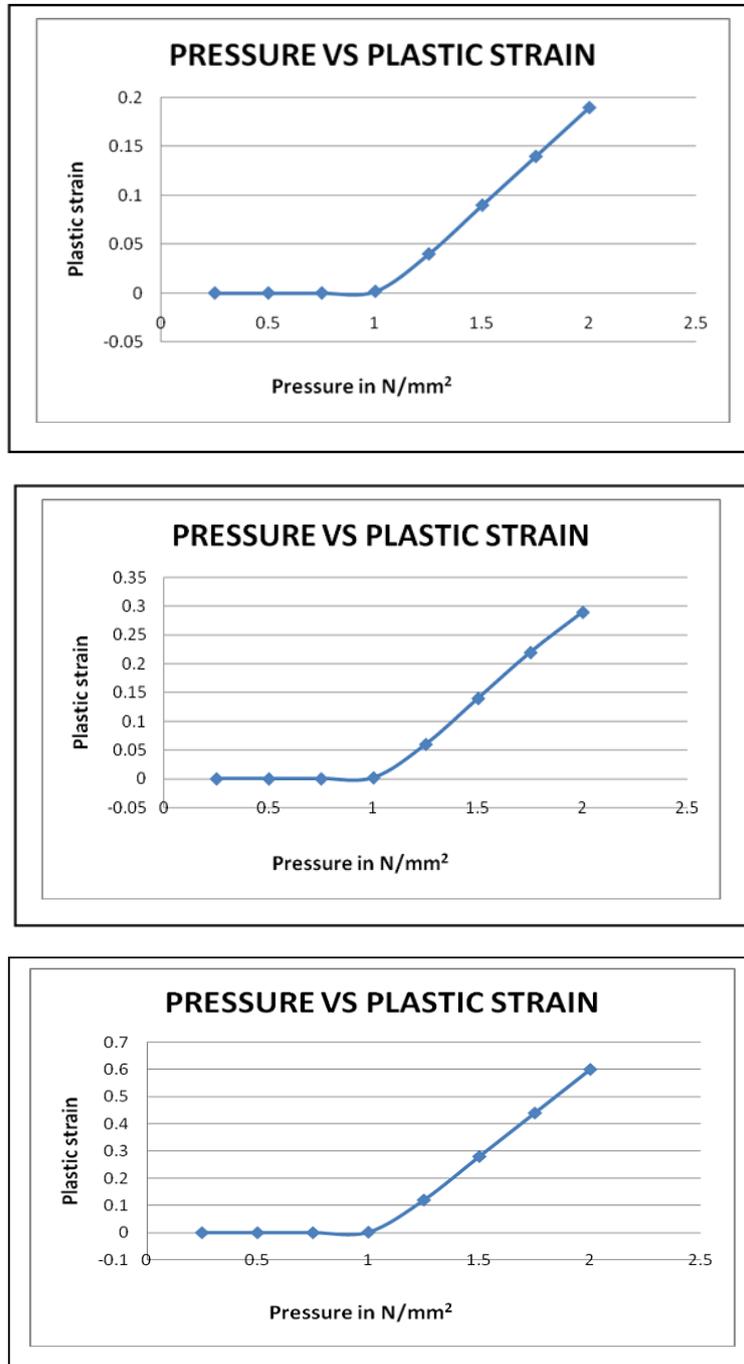


Figure 12: Shows the effect of pressure on plastic strain in bellow at (a) tangential modulus is 1500 N/mm^2 (b) tangential modulus is 1000 N/mm^2 (c) tangential modulus is 500 N/mm^2

Figure 12 shows the effect of pressure on plain strain in cylindrical bellows at different tangential modulus such as 1500 N/mm², 1000 N/mm² and 500 N/mm² and the plain strain is constant upto certain pressures and increases as increases the pressure and the deformation varies with tangential modulus as shown in above figure, varies from 0.175 to 0.6 at pressure 2 N/mm² for different tangential modulus values same can be observed in figure 13.

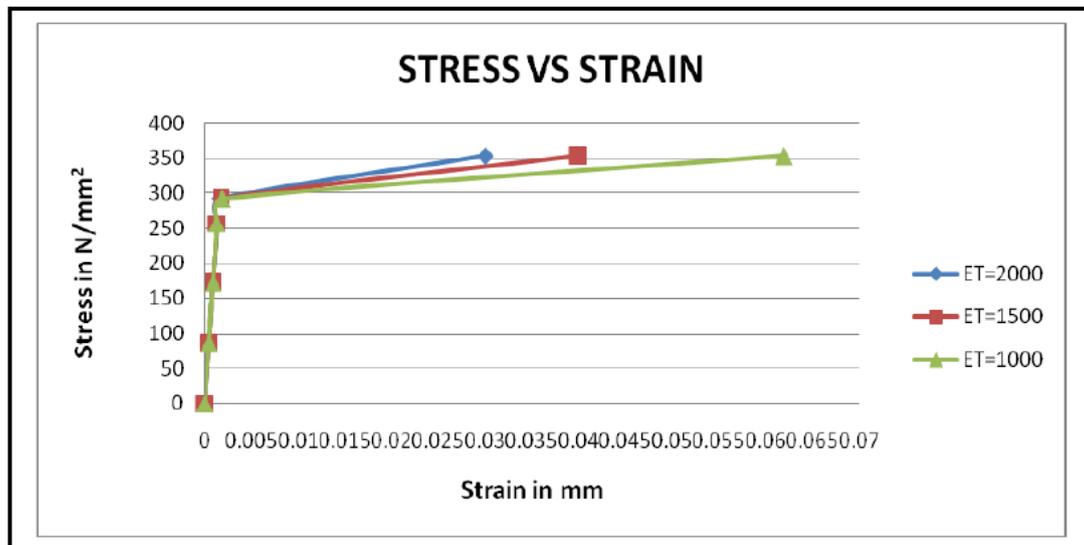


Figure 13: Shows the strain in the bellows at different stress of the tangential modulus.

Below the yield point plastic strain is almost nil, that is very small (0.0013). After the yield point plastic strain is started, similar to stress- strain curve for the material. To increase the tangential modulus strsin is decreases.

5. CONCLUSIONS

The effect of pressure on deformation, elastic stress and Plastic strains is observed. The Maximum values of deformation in bellow are 0.08 mm, 0.17 mm, 0.26 mm, 0.66 mm at pressures 0.25 N/mm², 0.5 N/mm², 0.75 N/mm² and 1N/mm² respectively.

The Maximum values of elastic stress in bellow are 85.81 N/mm², 171.62 N/mm², 257.43 N/mm² and 293.4 N/mm² at pressures 0.25 N/mm², 0.5 N/mm², 0.75 N/mm² and 1 N/mm² respectively.

The Maximum values of elastic strain in bellow are 0.44e-3, 0.88e-3, 0.0013 and 0.0015 at pressures 0.25 N/mm², 0.5 N/mm², 0.75 N/mm² and 1 N/mm² respectively.

The Maximum values of plastic strain in bellow are 0, 0, 0, 0.001, 0.003, 0.07, 0.1 and 0.14 at pressures 0.25 N/mm², 0.5 N/mm², 0.75 N/mm², 1 N/mm², 1.25 N/mm², 1.5 N/mm², 1.75 N/mm² and 2 N/mm² respectively.

At the tangential modulus 1500 N/mm², 1000 N/mm² and 500 N/mm², the Maximum values of plastic strain in bellows are (0, 0, 0, 0.0017, 0.04, 0.09), (0, 0, 0, 0.0018, 0.06, 0.14) and (0, 0.08, 0.4, 0.7) at pressures 0.25 N/mm², 0.5 N/mm², 0.75 N/mm², 1 N/mm², 1.25 N/mm² and 1.5 N/mm².

REFERENCES

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