TOWARDS IMPROVED BAGASSE DEWATERING

By

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Commercial milling units

- Six roll mill – typical in Australian sugar industry
- Four roll mill – many overseas
- Bundaberg High extraction Mill (Batstone et al, 2001):
  - two roll mill with the axis of the two rolls on the same horizontal plane
  - Low final moisture and modest specific power consumption, up to 450 t/h
- Mill Max (Trancart, 2008):

  - three roll mill with no trash plate and a ‘re-absorption limiting device’, up to 900 t/h

Incentives for improvement

- Australian sugar mills are mainly adopting Cogeneration as diversification projects
- Move towards diffusers overseas, instead of milling trains
  - Overall lower steam on cane
  - Diffuser trains typically produce higher moisture bagasse
  - Performance of dewatering mills becomes more important
- Possible use of sweet sorghum as additional feed
  - Prepared sweet sorghum is similar to prepared cane

Incentives for improvement (cont)

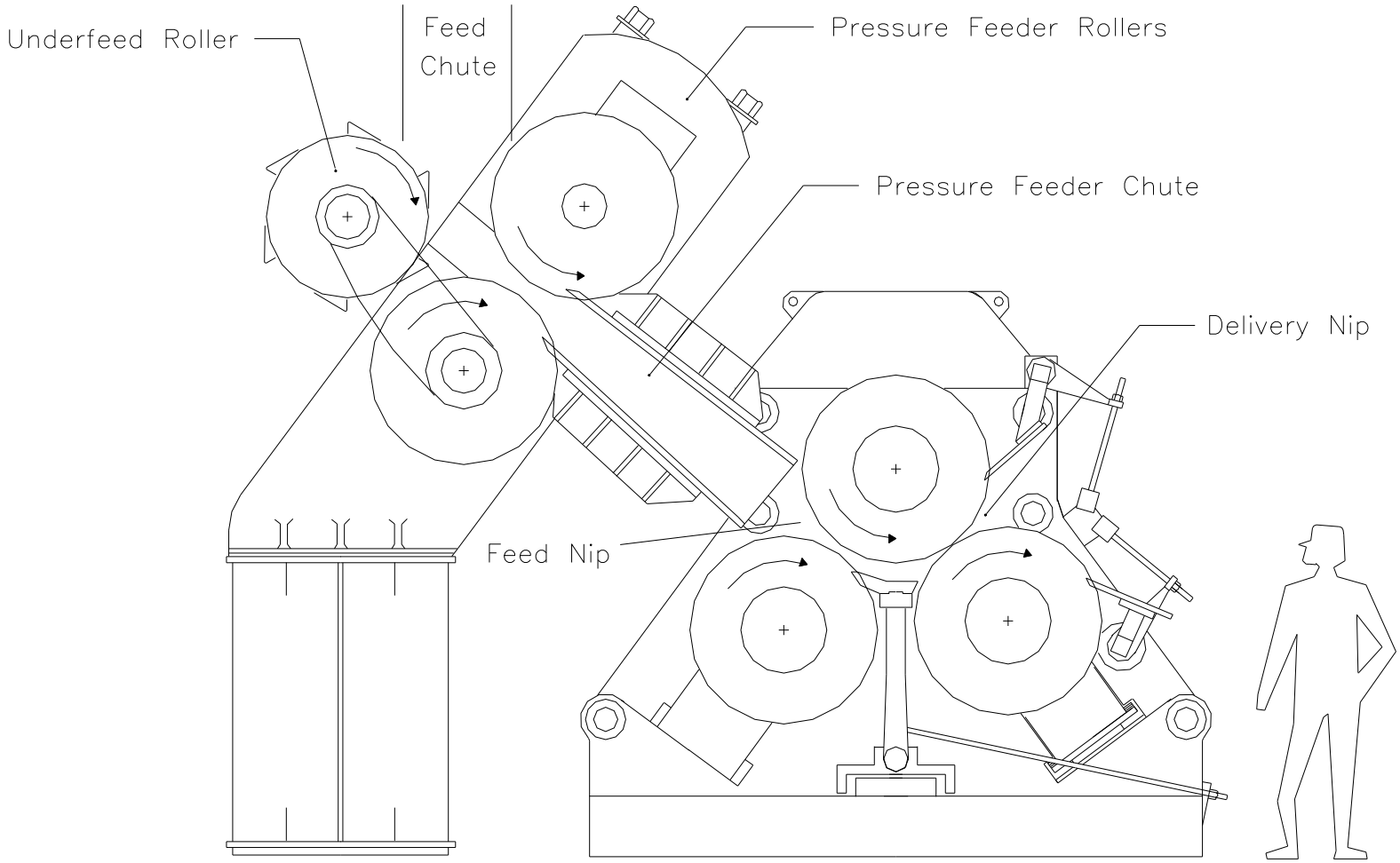
- Reducing bagasse moisture from 50% to 45% for an Australian sugar mill crushing at 500 t/h will -
  - result in an additional 9 250 tonnes of surplus combustible fibre
  - generate green electricity, save approximately 12 000 tonnes of greenhouse gases
  - At a price of $80 a tonne of combustible fibre, provide an extra $740 000 income per year,
  - Extra sugar, $167 000 per year at $400/tonne
  - Existing experimental data suggests that there is a significant quantity of re-absorbed juice in final bagasse



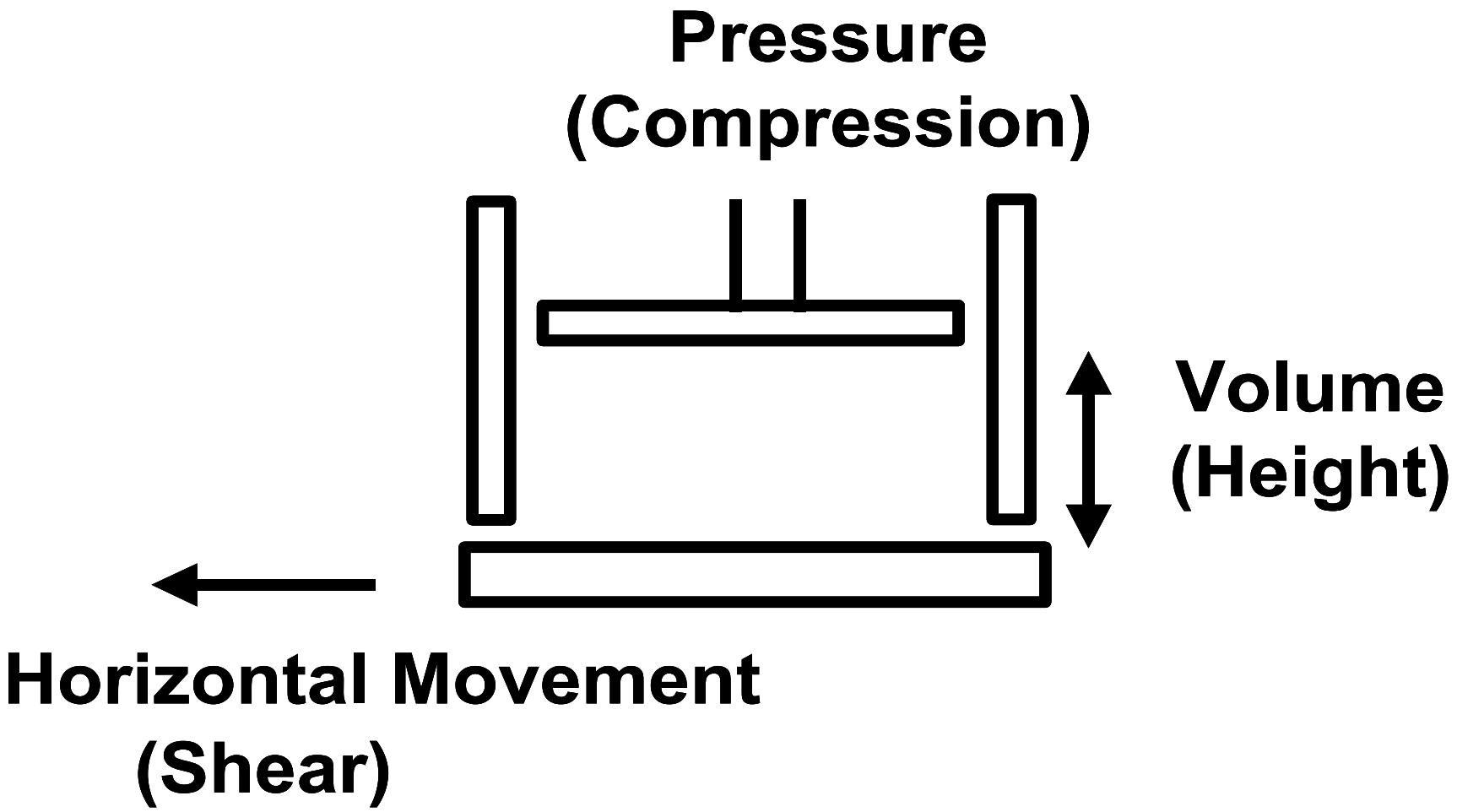
Aim – to reduce final bagasse moisture

One avenue towards achieving improvement

- Achieving a better understanding of the behaviour of prepared cane and bagasse
- Together with a milling model which contains a material model that reproduces the behaviour



Australian 6-roll milling unit with heavy duty pressure feeder



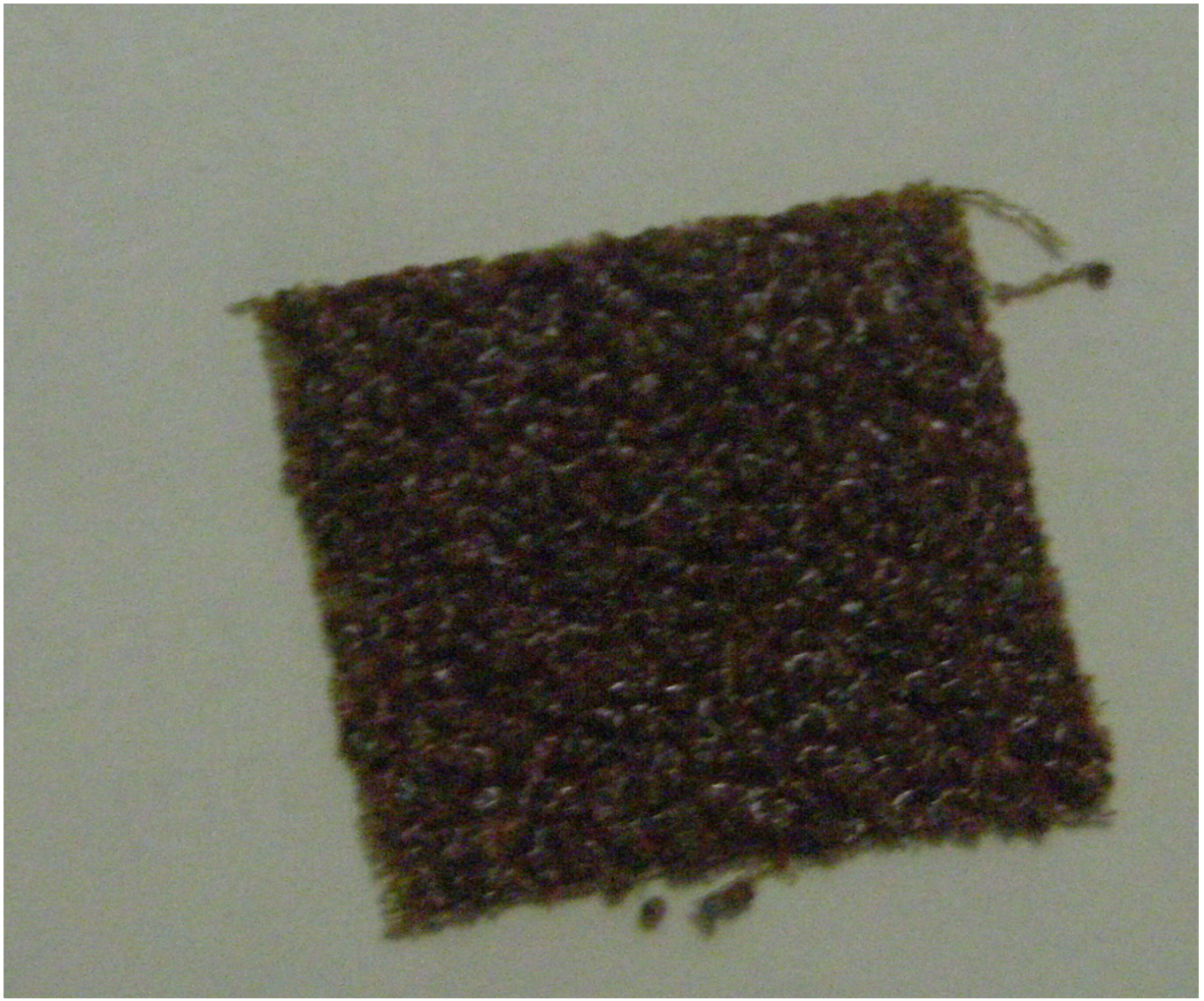
Simple laboratory tests



Juice expressed



Compressing and shearing



P24 closed coat sandpaper – 1 mm diameter grains

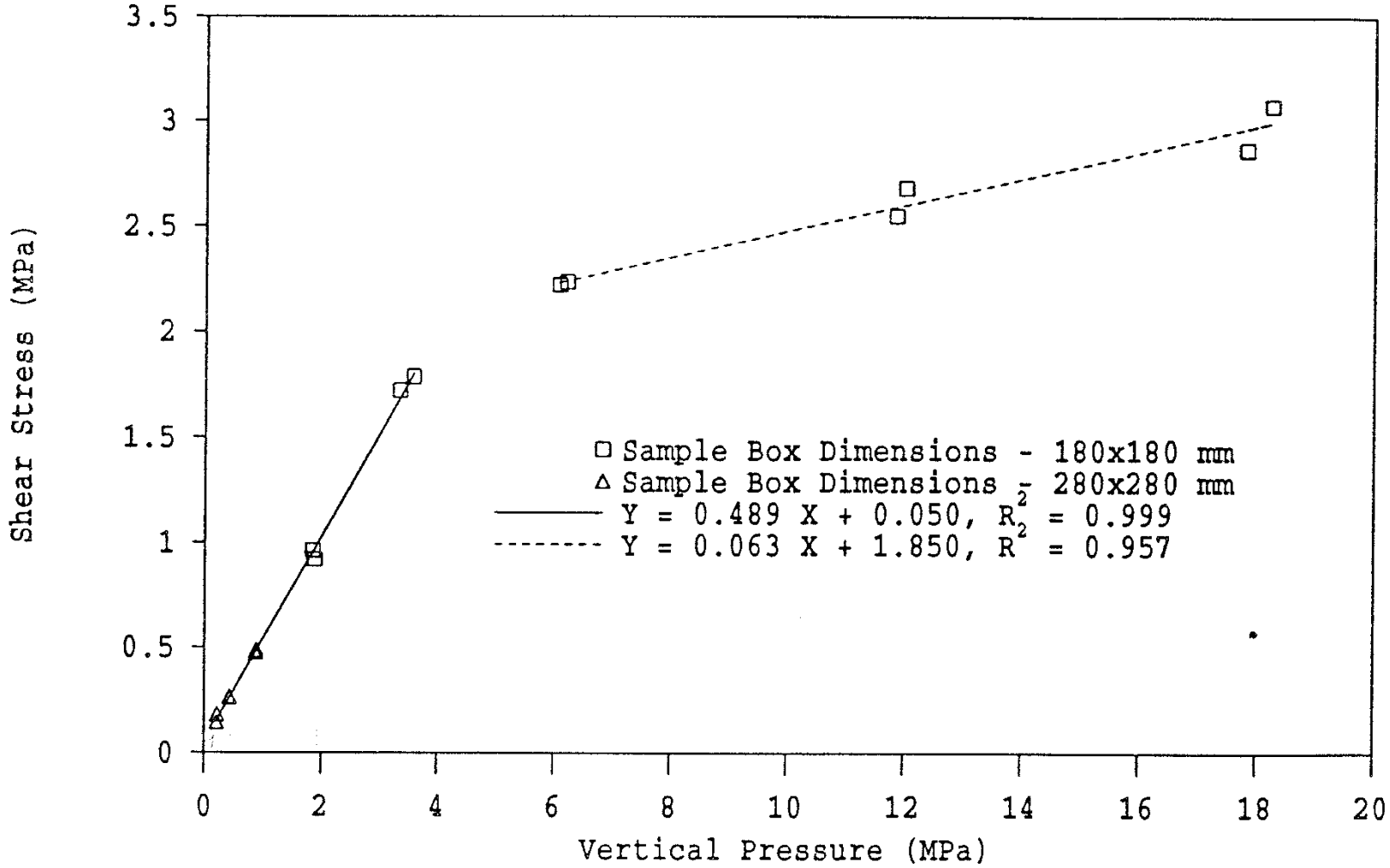
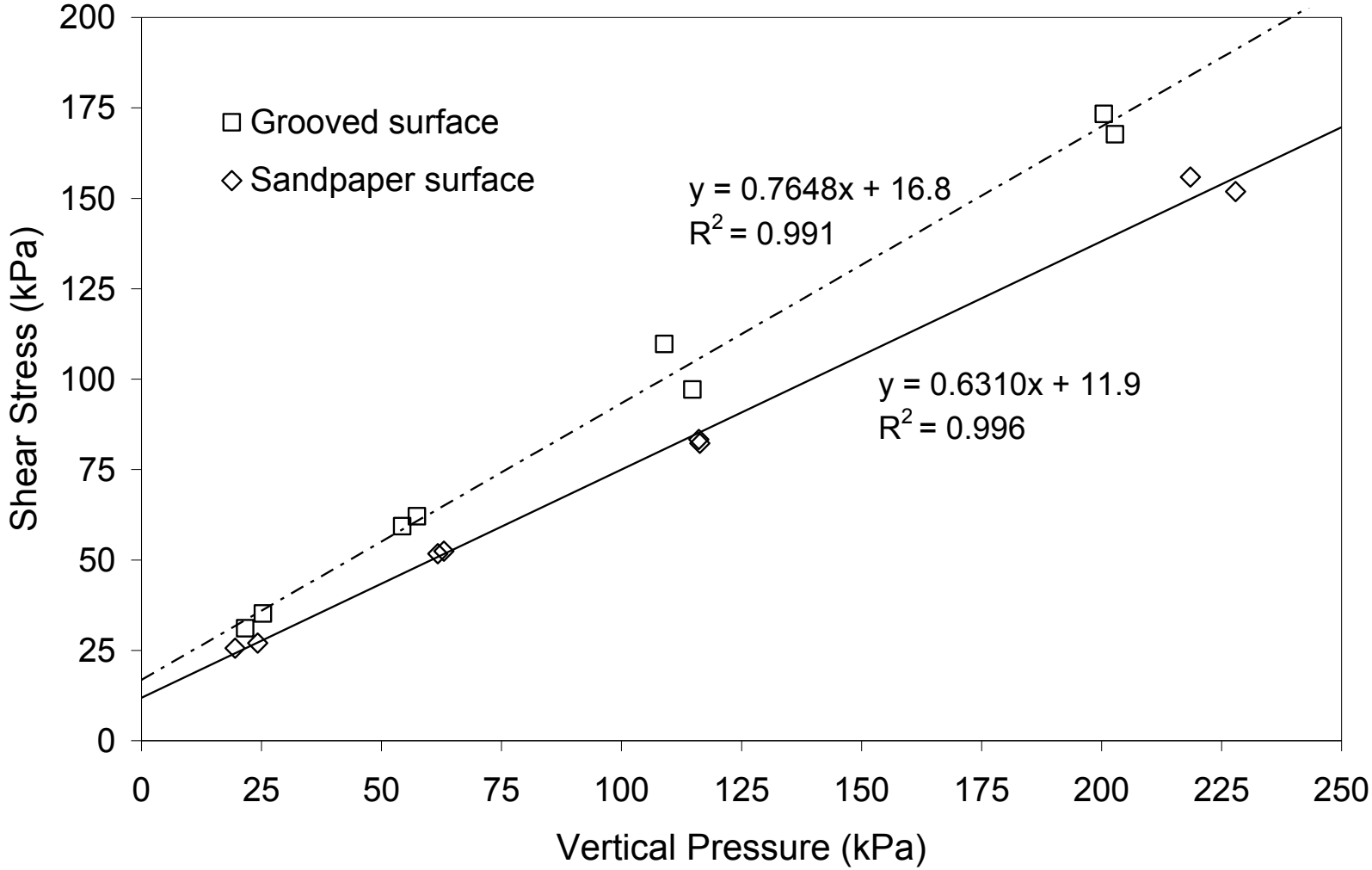
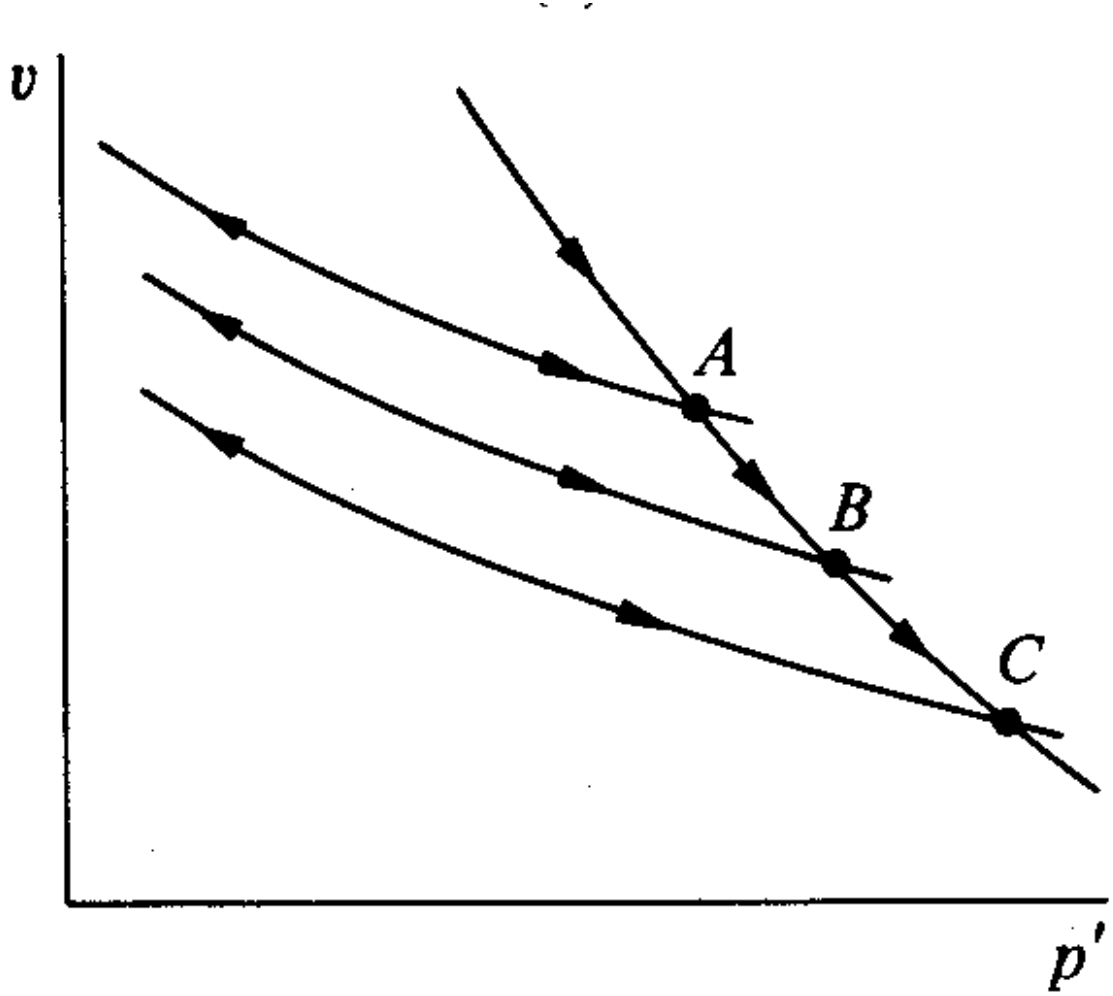


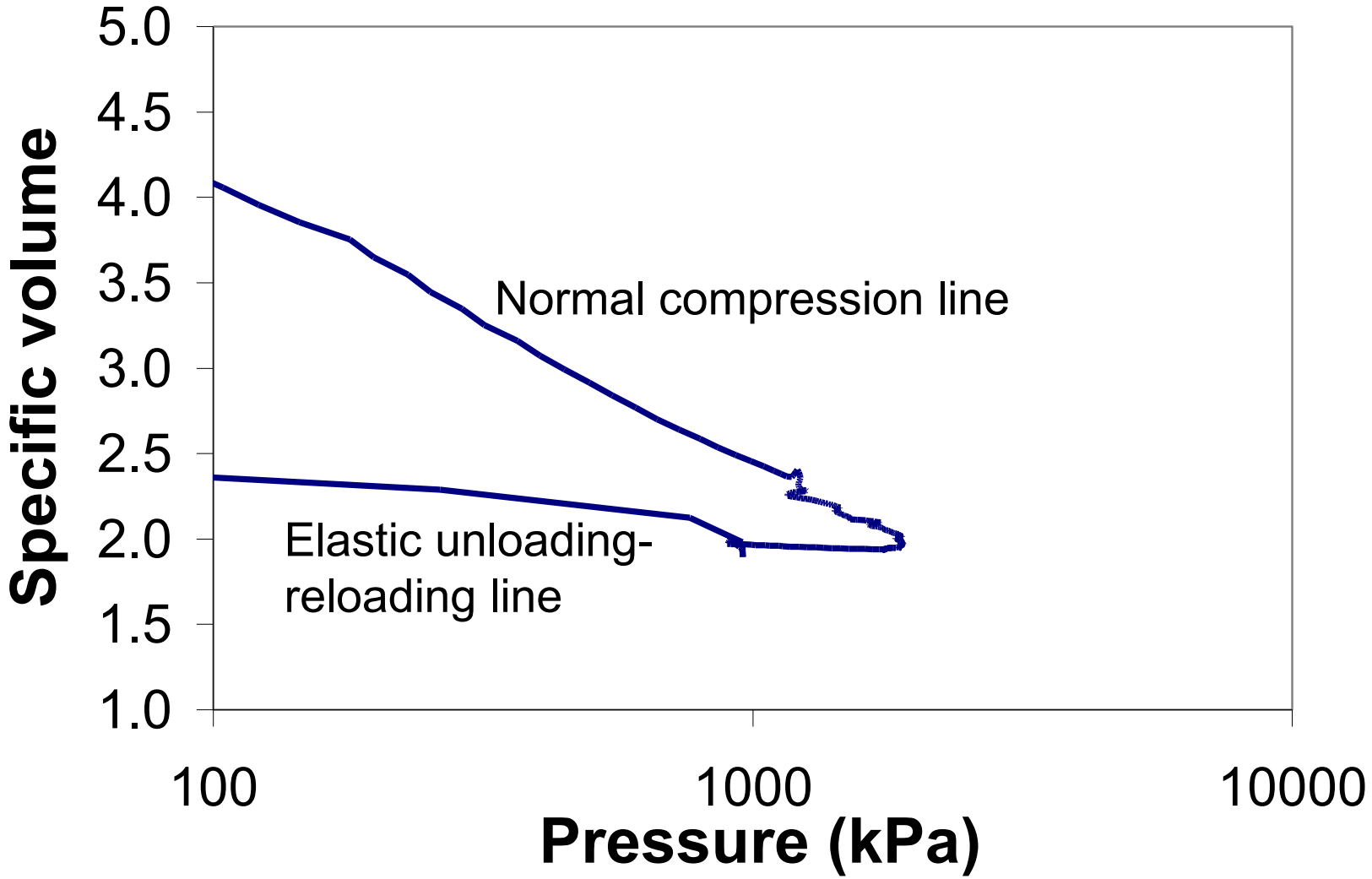
Figure 5.3. Shear Stress Plot for P24 Closed Coat Sandpaper Tests.



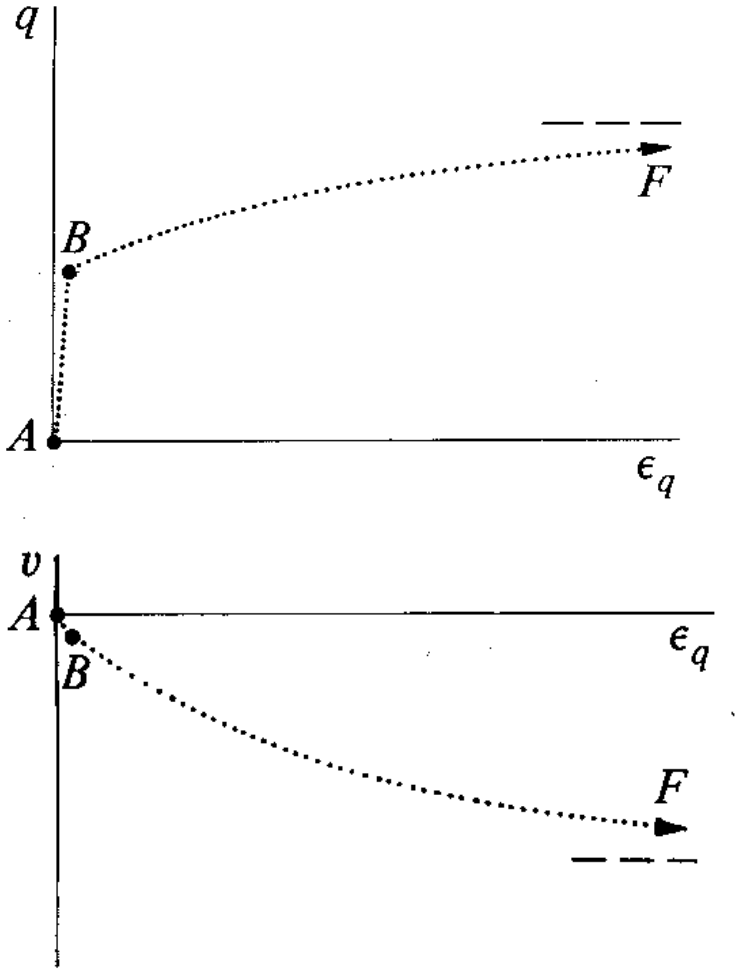
Previous work - cohesion and friction at low pressures for prepared cane



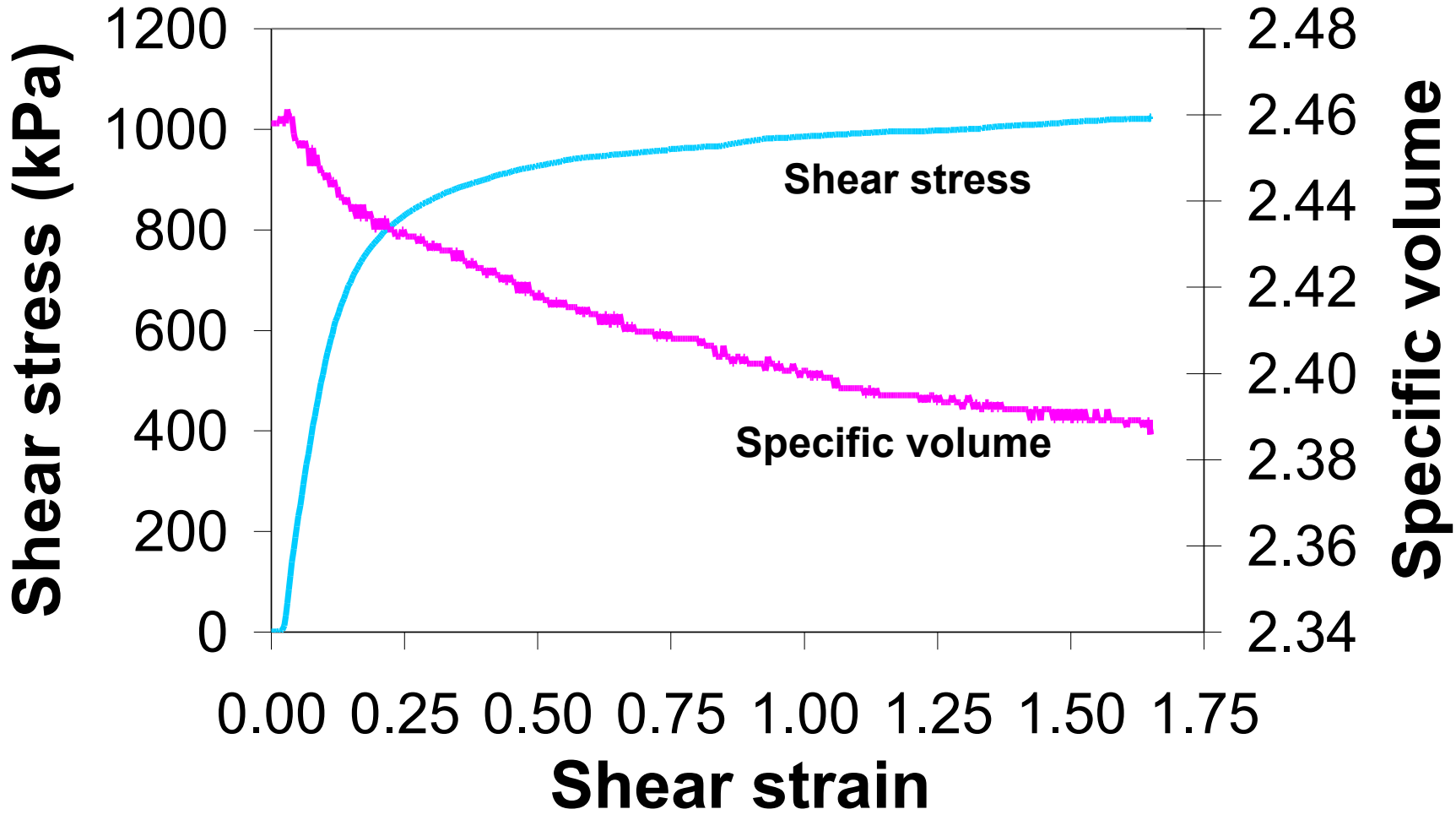
COMPRESSION (MUIR WOOD, 1990)



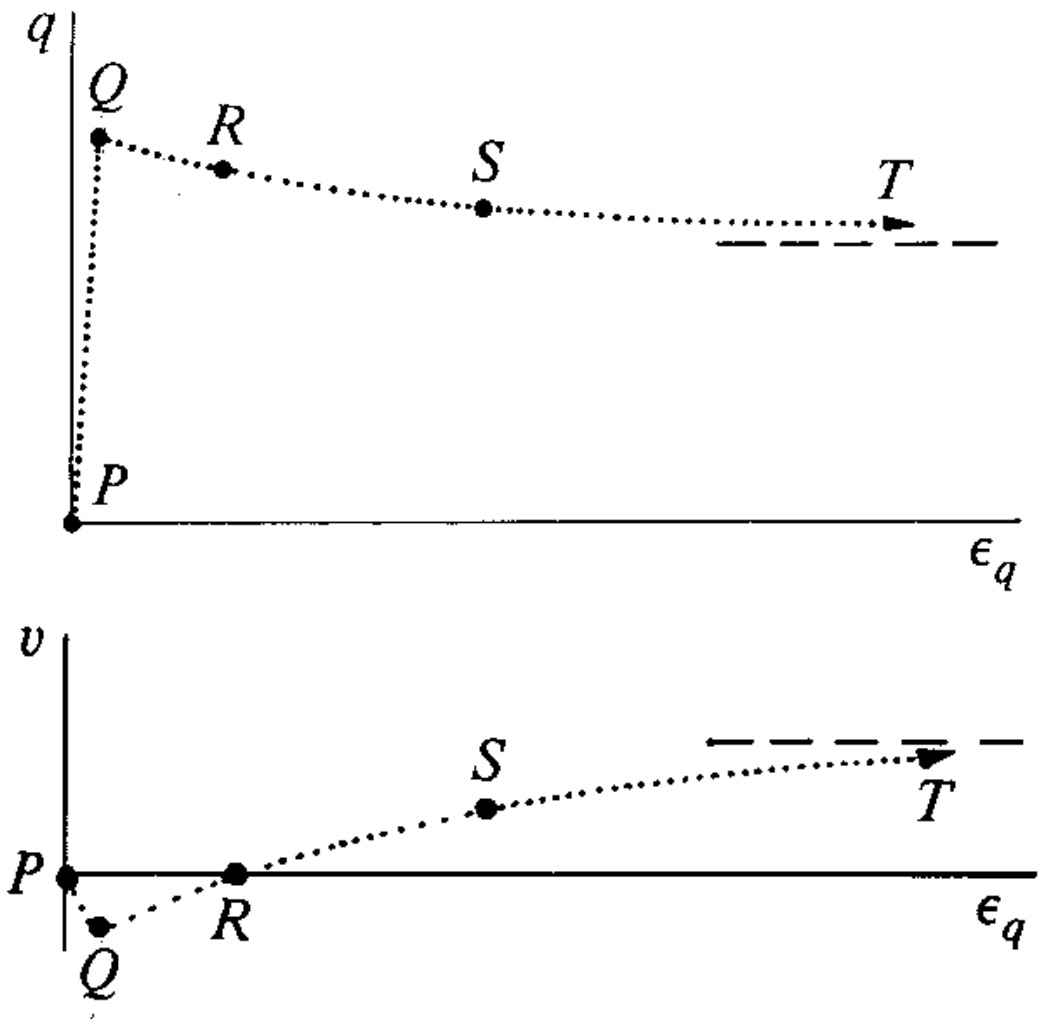
Compression behaviour of final mill bagasse



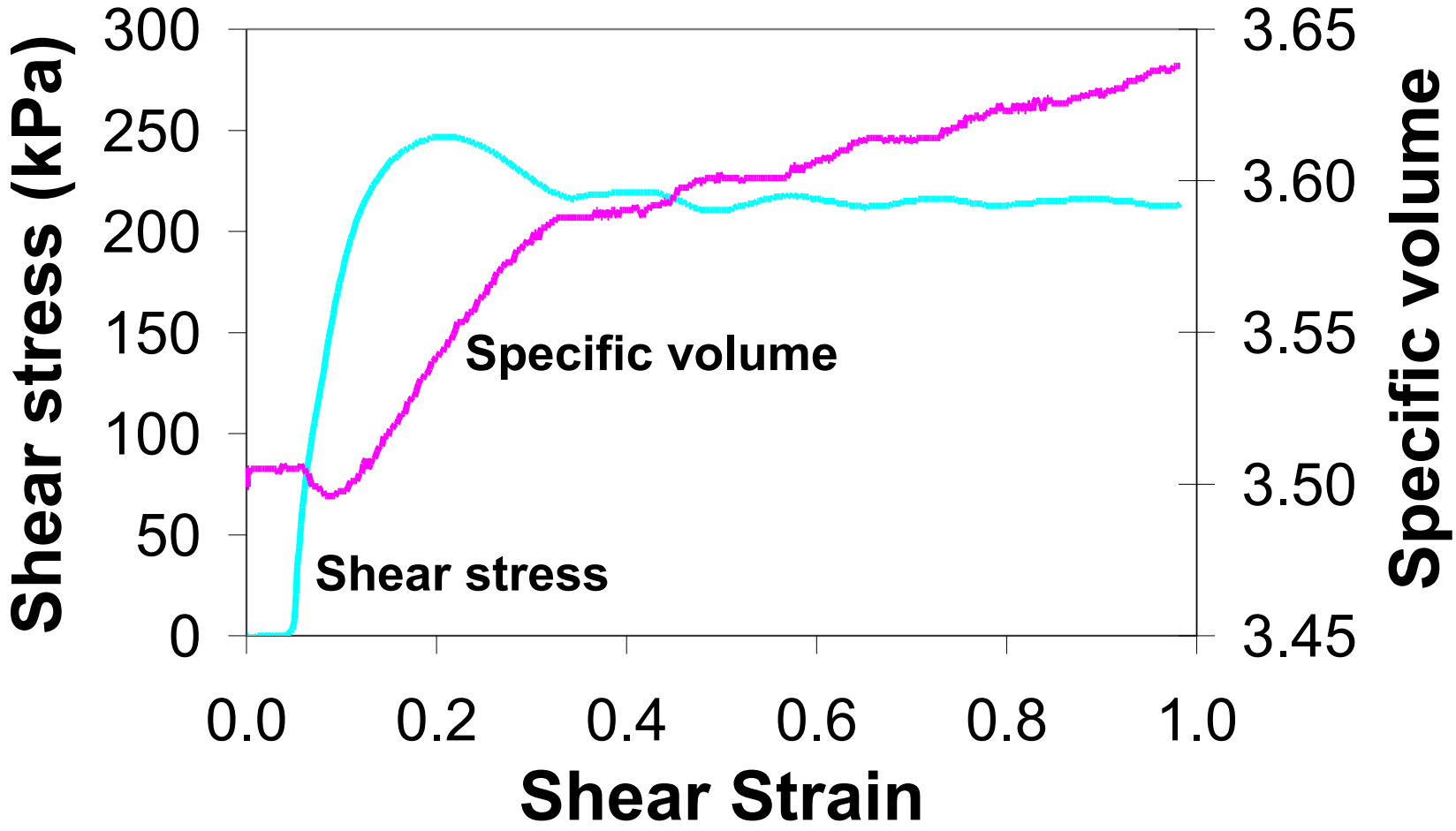
SOIL UNDERGOING SHEAR STRAIN (MUIR WOOD, 1990)



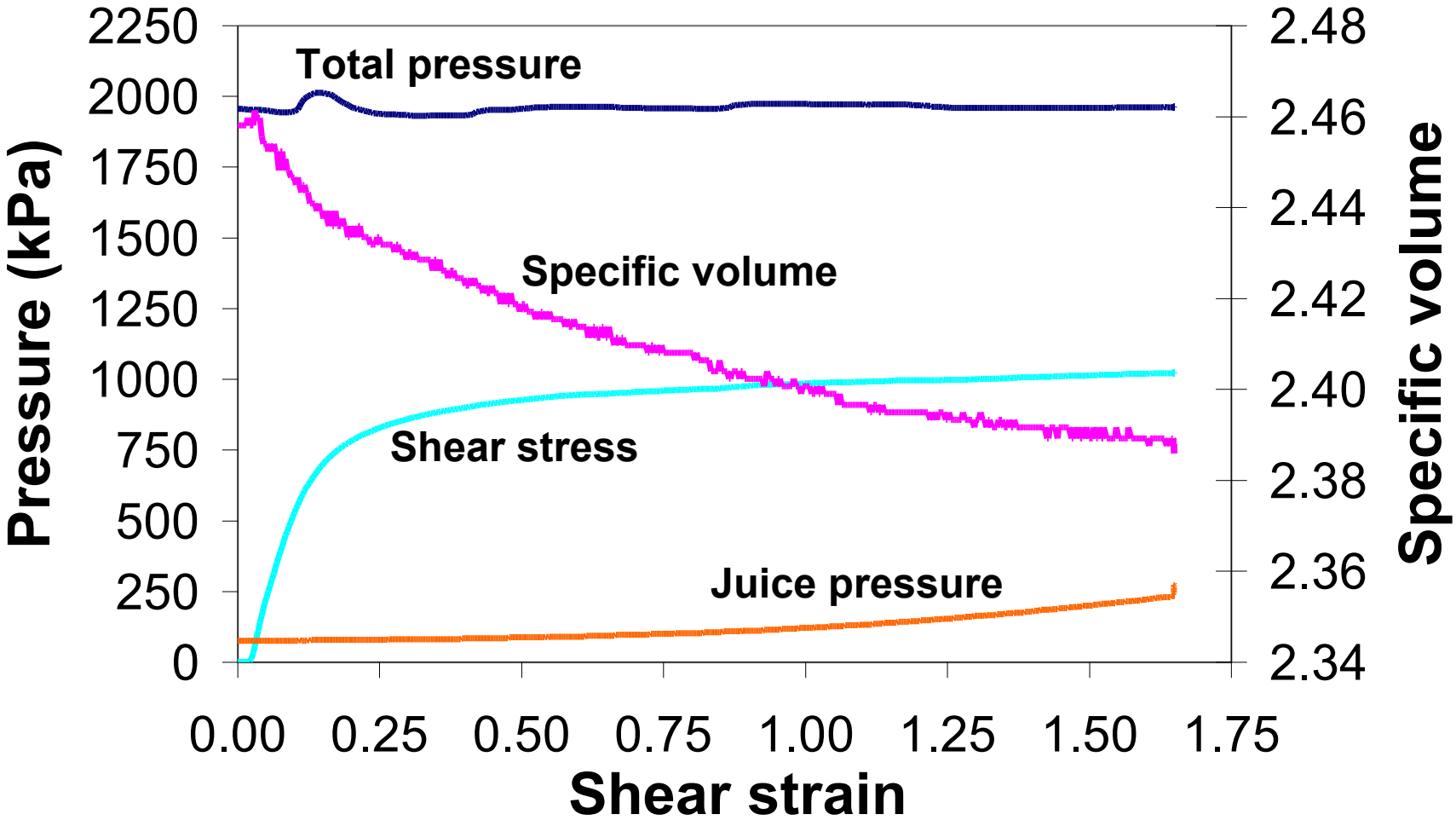
Shear stress and specific volume vs shear strain for lightly over-consolidated first mill bagasse



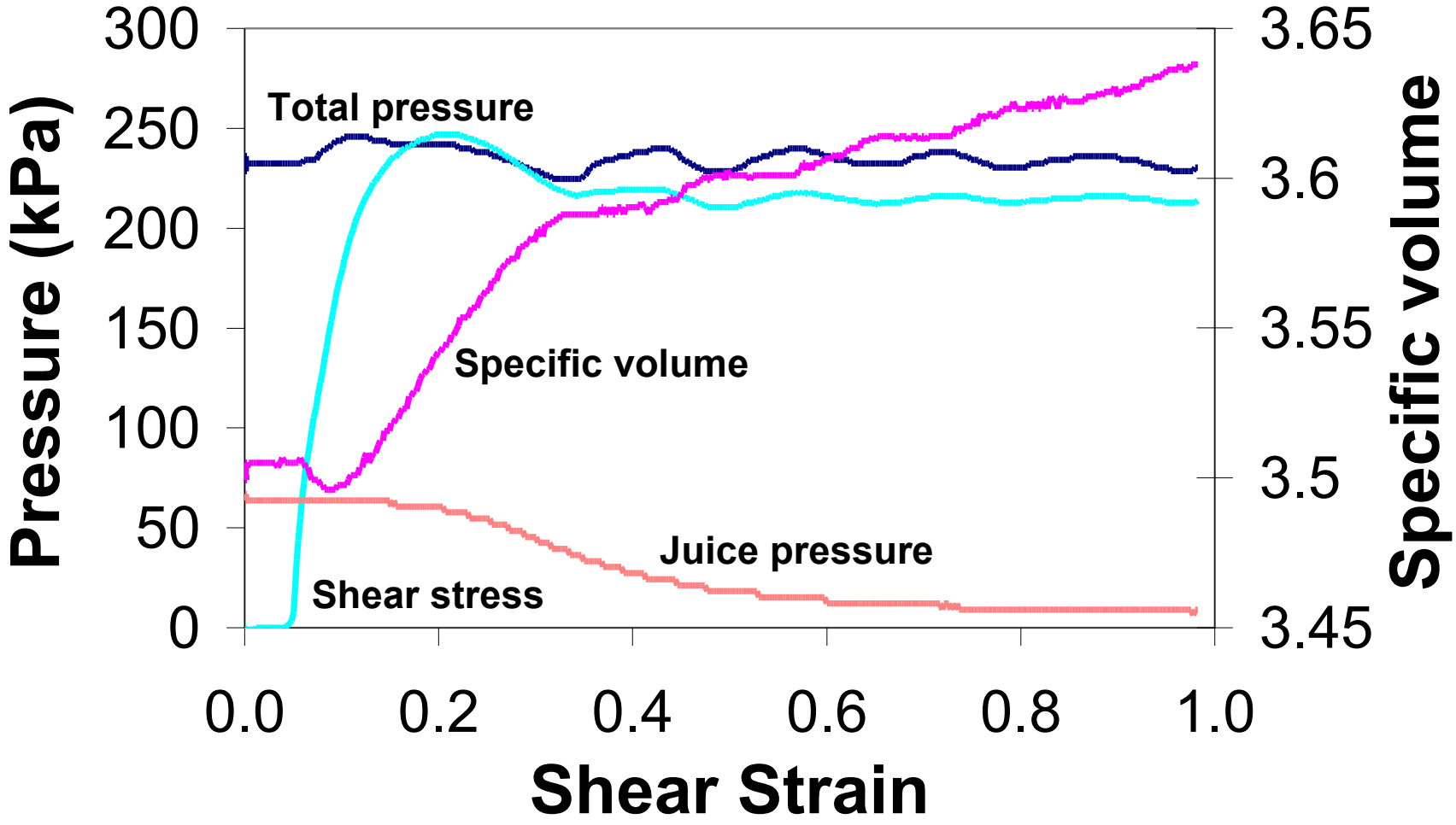
IDEALISED BEHAVIOUR OF A HIGHLY OVERCONSOLIDATED SOIL UNDERGOING SHEAR STRAIN (MUIR WOOD, 1990)



Shear stress and specific volume vs shear strain for highly over-consolidated first mill bagasse



Overall behaviour during shearing for lightly over-consolidated first mill bagasse



Overall behaviour during shearing for highly over-consolidated first mill bagasse

1998 – 2001 A major improvement in understanding

BEFORE



AFTER



- Basic compression and volume behaviour

Unified Critical State Behaviour

- Plastic and elastic behaviour
- Compression
- Volume
- Shear

For future improvements to milling

- Need specific Critical State material model for bagasse
- Coded as a separate subroutine into commercial software

Material model

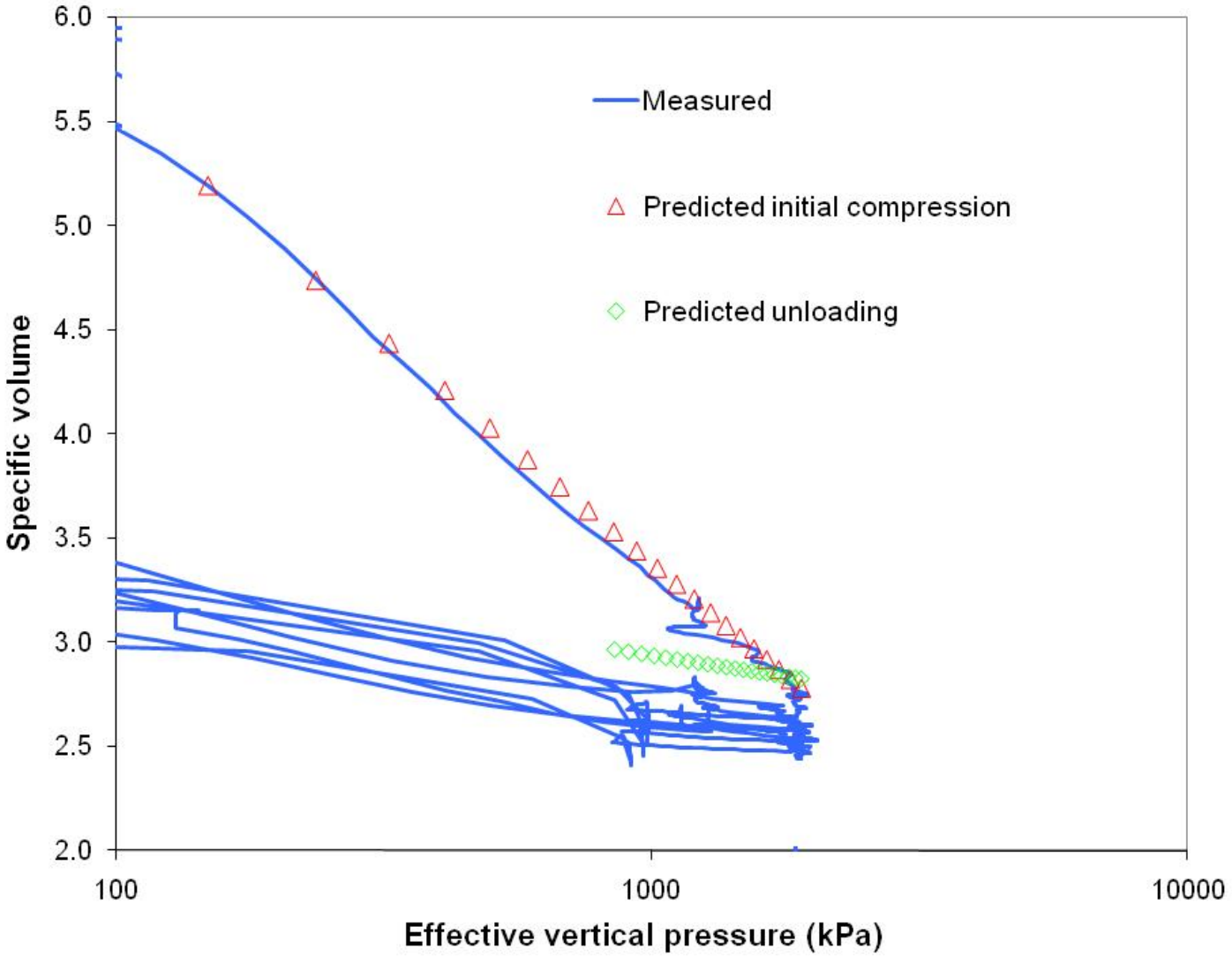
- Upgrade to Modified Cam Clay model by de Souza Neto et al. (2008) to include cohesion
  - Relatively easy to code as a Fortran subroutine based on previous work

- Flexibility increased of Modified Cam Clay model with cohesion, as per previous work, by separately defining the shapes of the yield surface and the potential surface

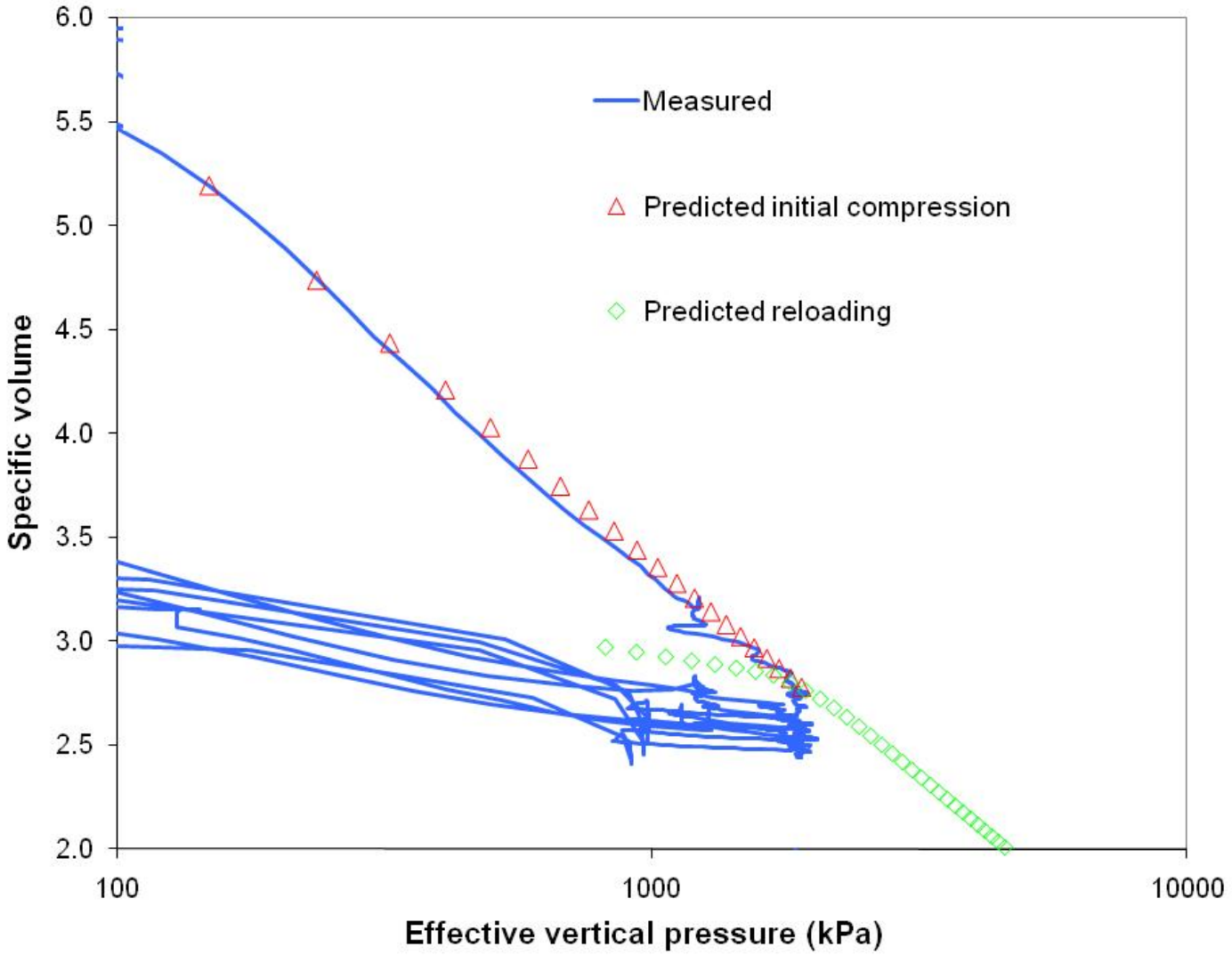
- Further modifications carried out to improve shear predictions

Five simple loading cases

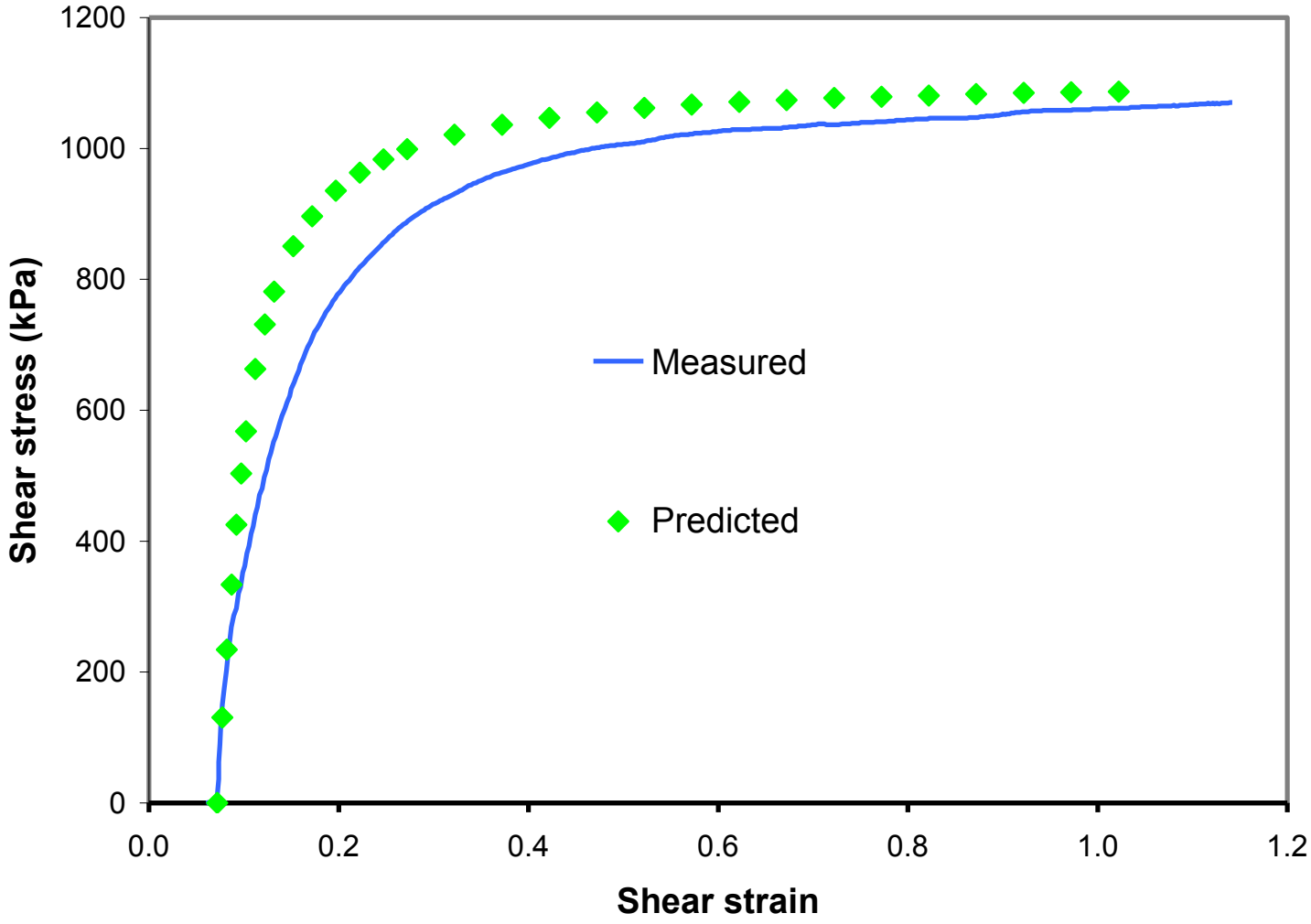
- Initial loading in compression
- Unloading in compression
- Reloading in compression
- Shearing of normally consolidated bagasse
  - shear stress
  - volume change
- Shearing of heavily over-consolidated bagasse
  - shear stress
  - volume change
  -



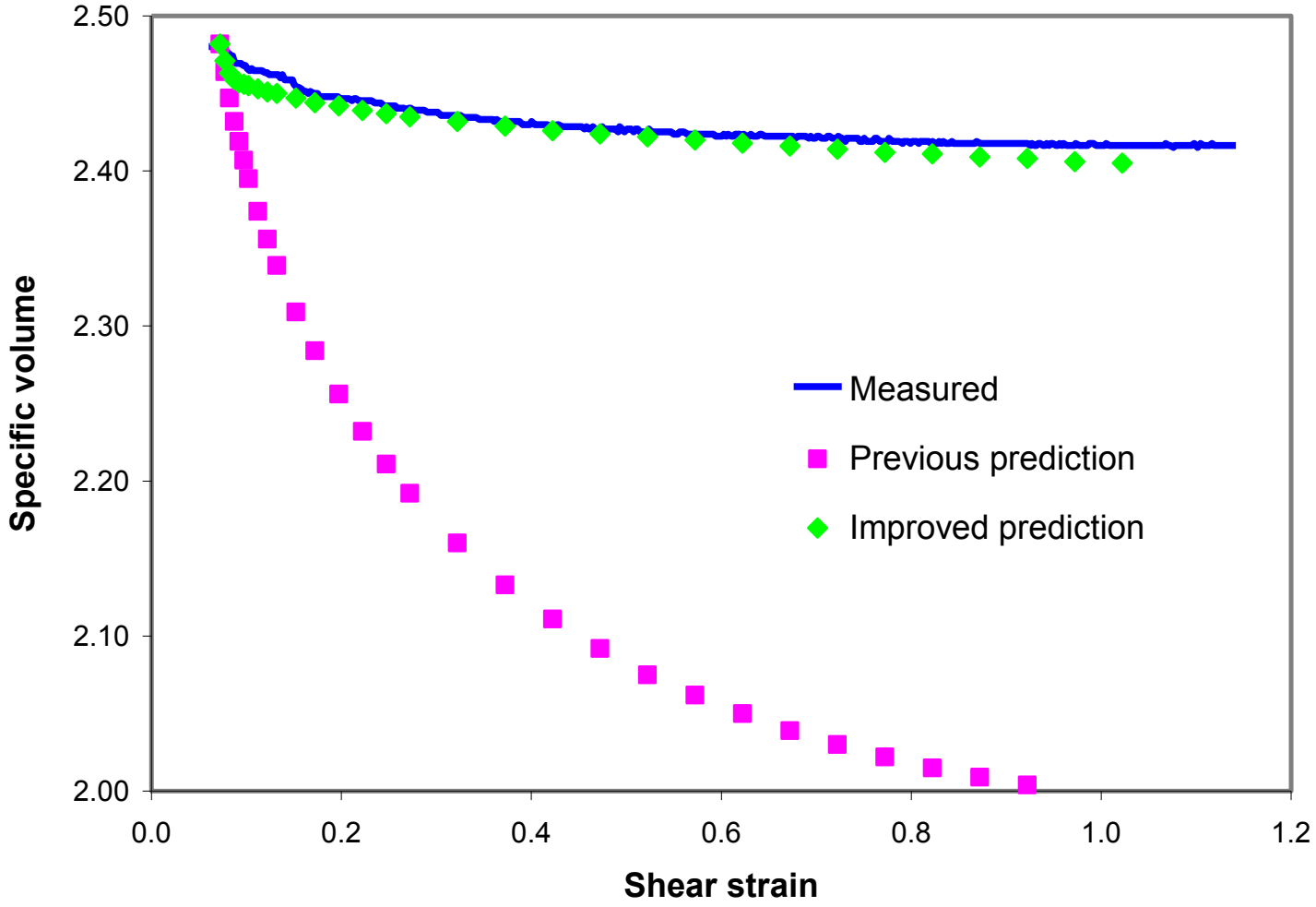
Comparison of predictions for loading and unloading in compression with measured data – good prediction, as good as previously achieved



Comparison of predictions for loading and re-loading in compression with measured data – good prediction, as good as previously achieved



Comparison of stress predictions for shearing of a normally consolidated sample with measured data – good prediction, as good as previously achieved



Comparison of specific volume predictions for shearing of a normally consolidated sample with measured data – a much better prediction than previously achieved

Small but significant improvement

- Much improved prediction of volume change during shear
- Most of the volume change for bagasse is due to compression rather than shear
- Improved prediction of the volume change due to shear should give better prediction of roll load and therefore torque.

Future Work :

- One remaining loading condition out of five to be tested:
  - shearing of highly over-consolidated bagasse

