The PETshop toys. Of eVacs, Nanovacs and PSAs

David Still with

Joanna Read, Mark O'Riordan, Simon Mckean, India Elsdon

Context

Manual

Semi-mechanised

Fully mechanised

Vacutug trials

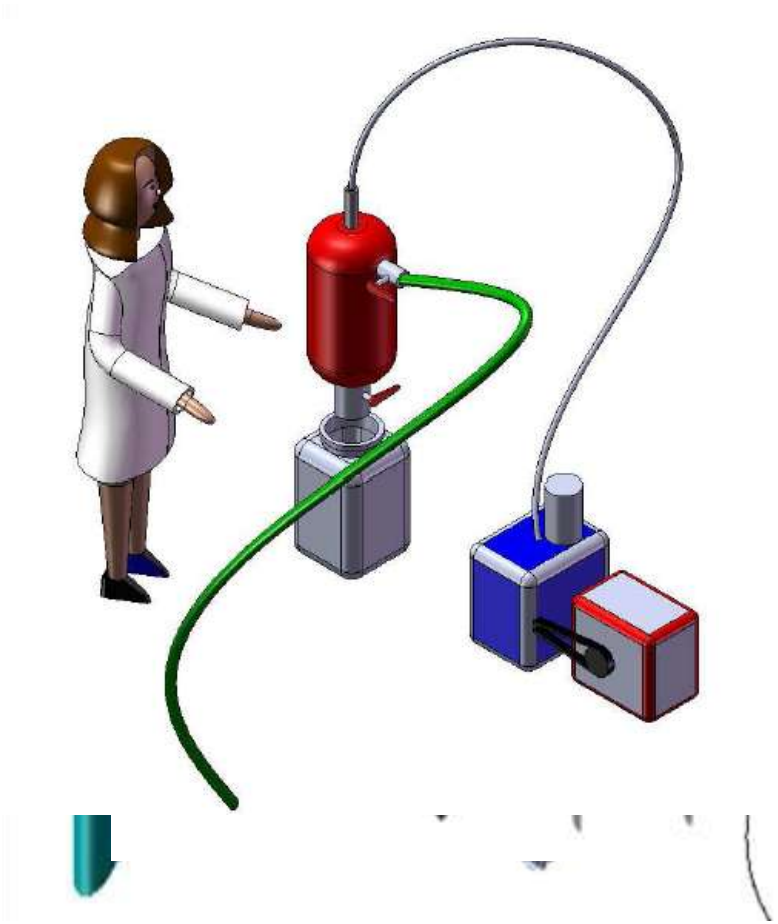
Vacutug trials


NU 5609

New devices

Three main ideas

- ‘Gobbler’
- ‘Pit Screw Auger’
- ‘Nano Vac’



The Gobbler - Intro

Scoops to lift waste

Similar to Steve Sugdeon's 'Nibbler'

BUT

- More durable
- Waste falls easily from scoops

Gobbler – First prototypes

Issues

- Clogging
- Heavy
- High part count
- Multiple points of failure

Gobbler – Final prototype

Sprung scraper to remove waste from scoops

No bend = one chain = lower part count, weight

No cog at the bottom

Gobbler – Testing

Plain waste

With added paper

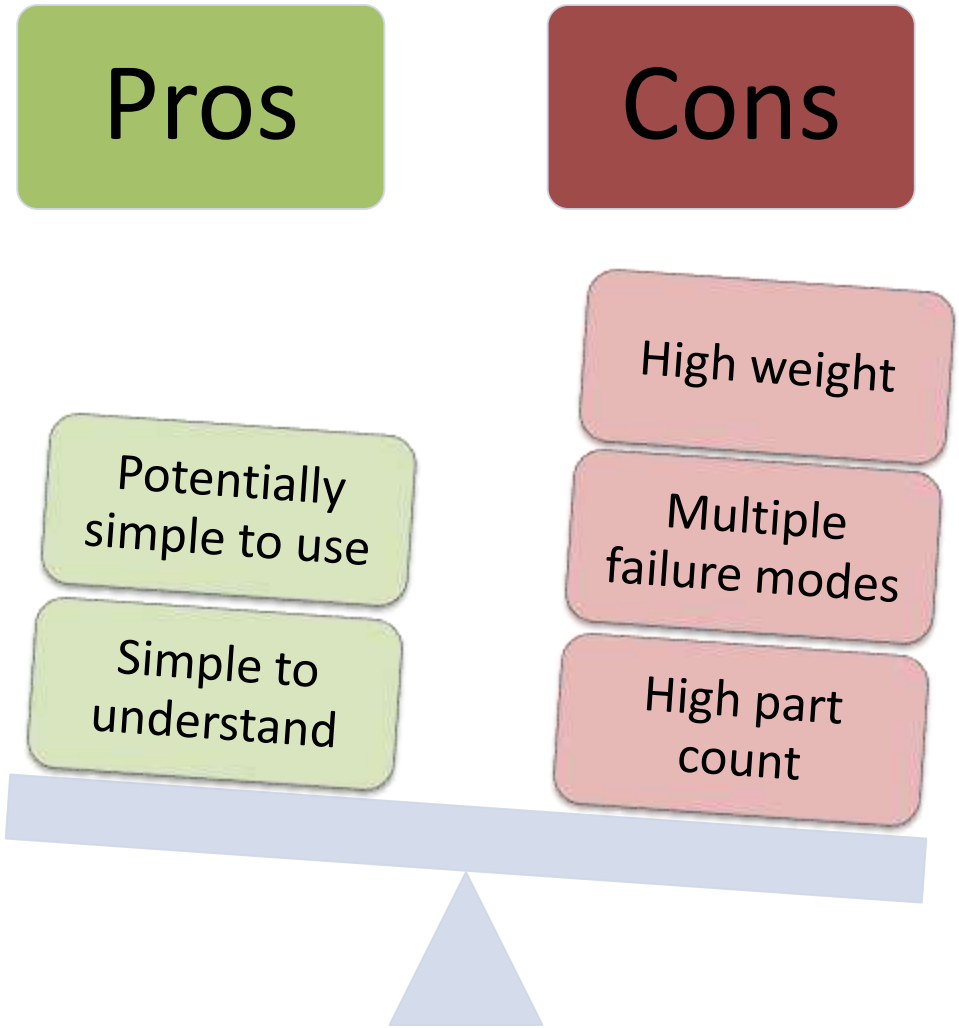
Gobbler - Conclusions

Clogging problem still not overcome

Part count still very high, leading to multiple failure modes

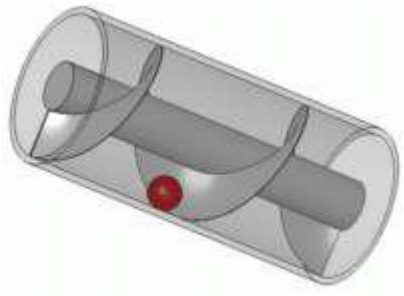
Total cost of final prototype: R4,500

Emptying rate:
plain waste: 9 l/m
with paper: n/a



Pit Screw Auger - Intro

- Essentially a cross between an Archimedes screw and a fence post driller



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= ?

- Single person operation
- Waste lifted through pedestal, into container
- Previous attempt had been made, but with little success – the ‘Bangalore Screwer’

Pit Screw Auger – First prototypes

- A cranking speed of ~90 RPM required to lift waste
- Manual cranking too difficult
- 0.25kW motor, reduced to 90 RPM used

- Various pipe sizes used to shroud 100mm Ø auger

- Success found with 125mm Ø pipe shrouding 100mm Ø auger

Pit Screw Auger – Second prototypes

- How to get the waste out of the top?
  - 45^{o} tee was best solution, despite lack of height

- Auger must run for full length of shrouding to prevent compaction

- Auger sensitive to exact positioning
  - Needs ~5-10cm protruding from shroud at bottom
  - Top of auger needs to be in line with the bottom of the top opening

Pit Screw Auger - Testing

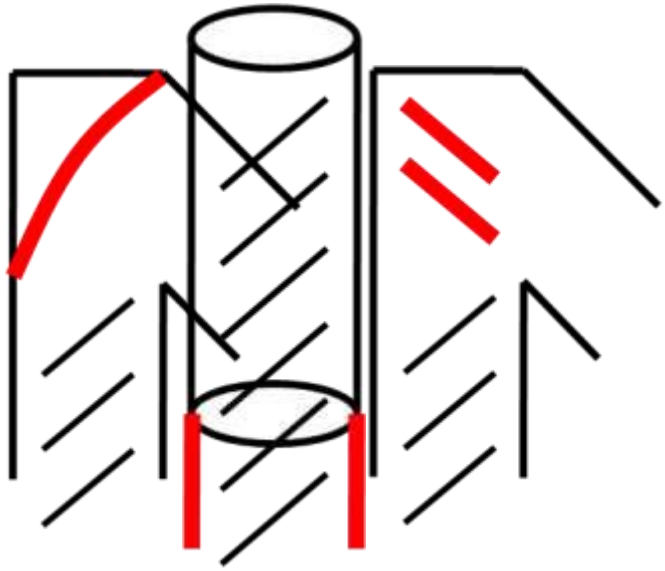
Plain waste

With added paper

Pit Screw Auger - Modifications

A number of observations were suggested following the first round of testing:

- Waste needs to be assisted to fall from the auger at the outlet
- 'legs' need to be added to prevent the PSA twisting when the auger touches the bottom of the pit
- It may be impossible to empty the final ~20cm of waste with the PSA



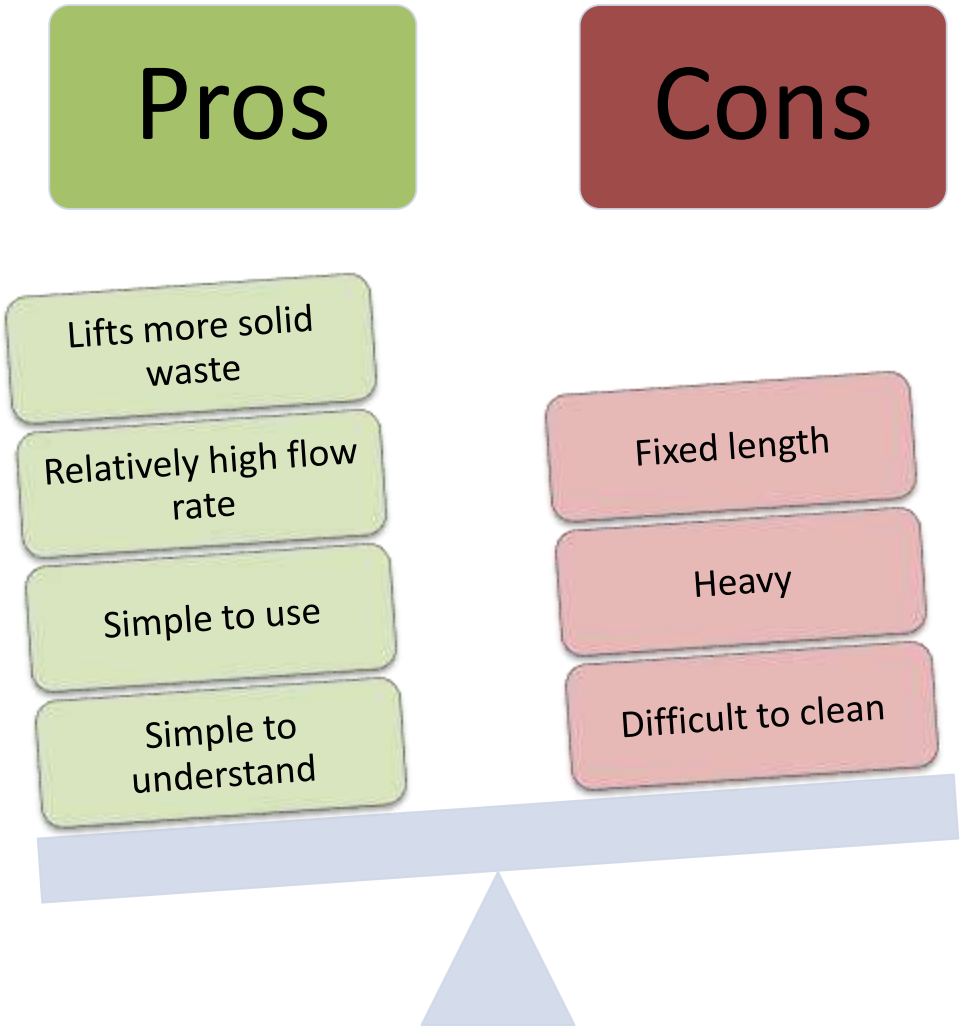
Pit Screw Auger - Conclusions

Looking very promising...

...ready to start trials?

Total cost of final prototype: R8,300

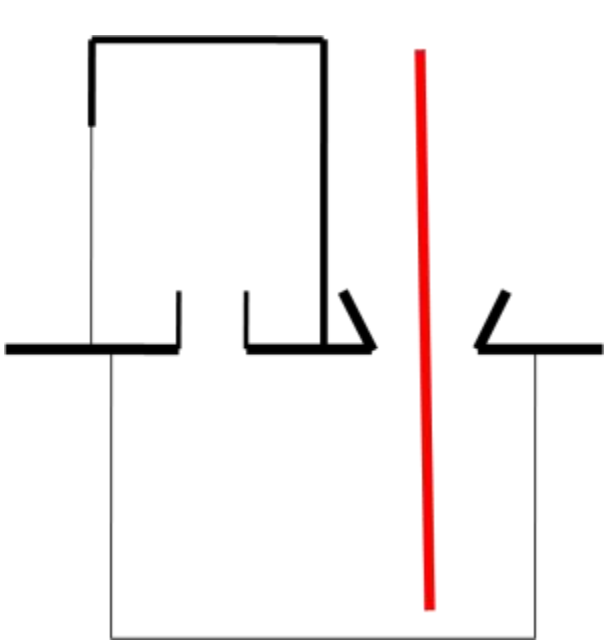
Emptying rate:
'clean' waste: 20 l/m
with paper: 7 l/m

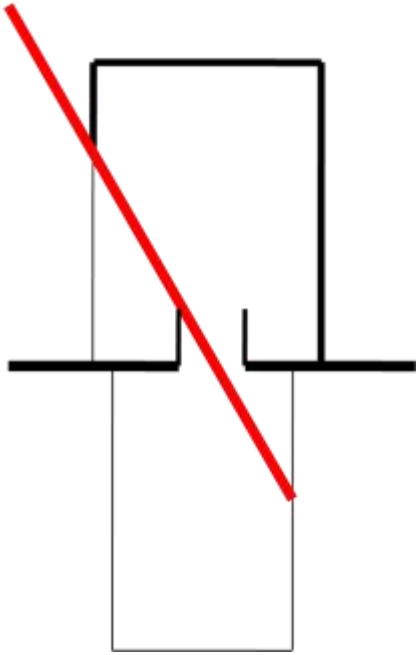


A note on fixed length pit emptiers

The fixed length of the Gobbler and the Pit Screw Auger presents an access problem.

Many latrines have an access hatch, but what can we do where the latrine needs to be accessed through the pedestal?



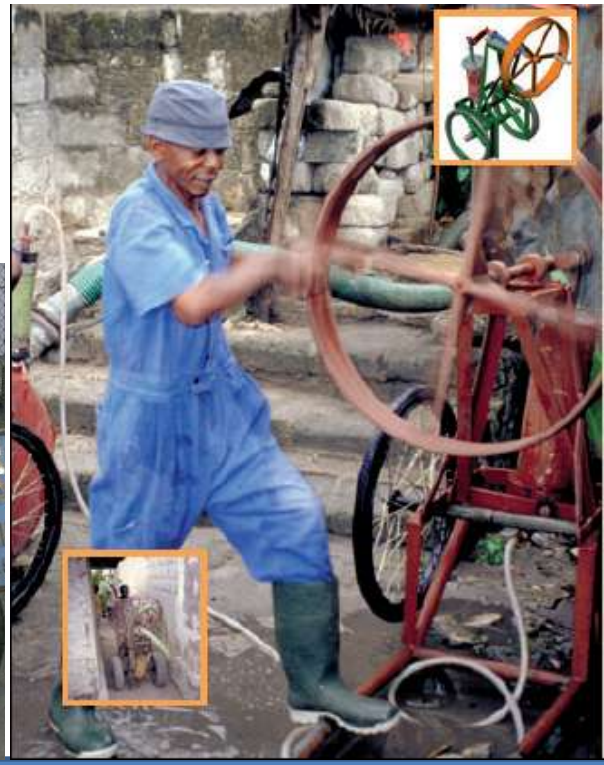


Nano Vac - Intro

A low cost alternative to the Vacutug which was:

- Smaller / more compact
- More easily manoeuvrable
- Parts more easily and cheaply sourced
- Cheaper to produce

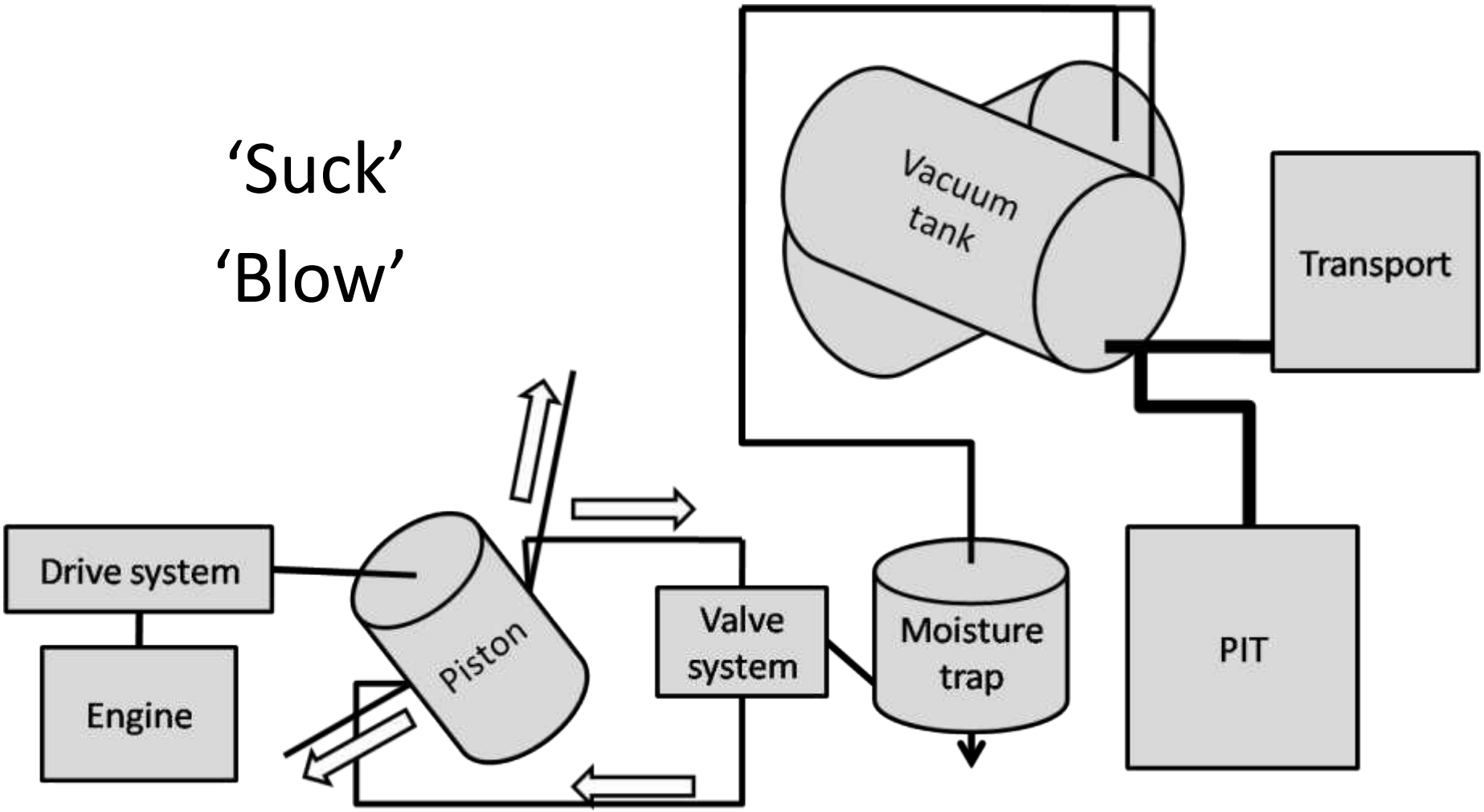
Design based largely on the MAPET system, though IC engine driven



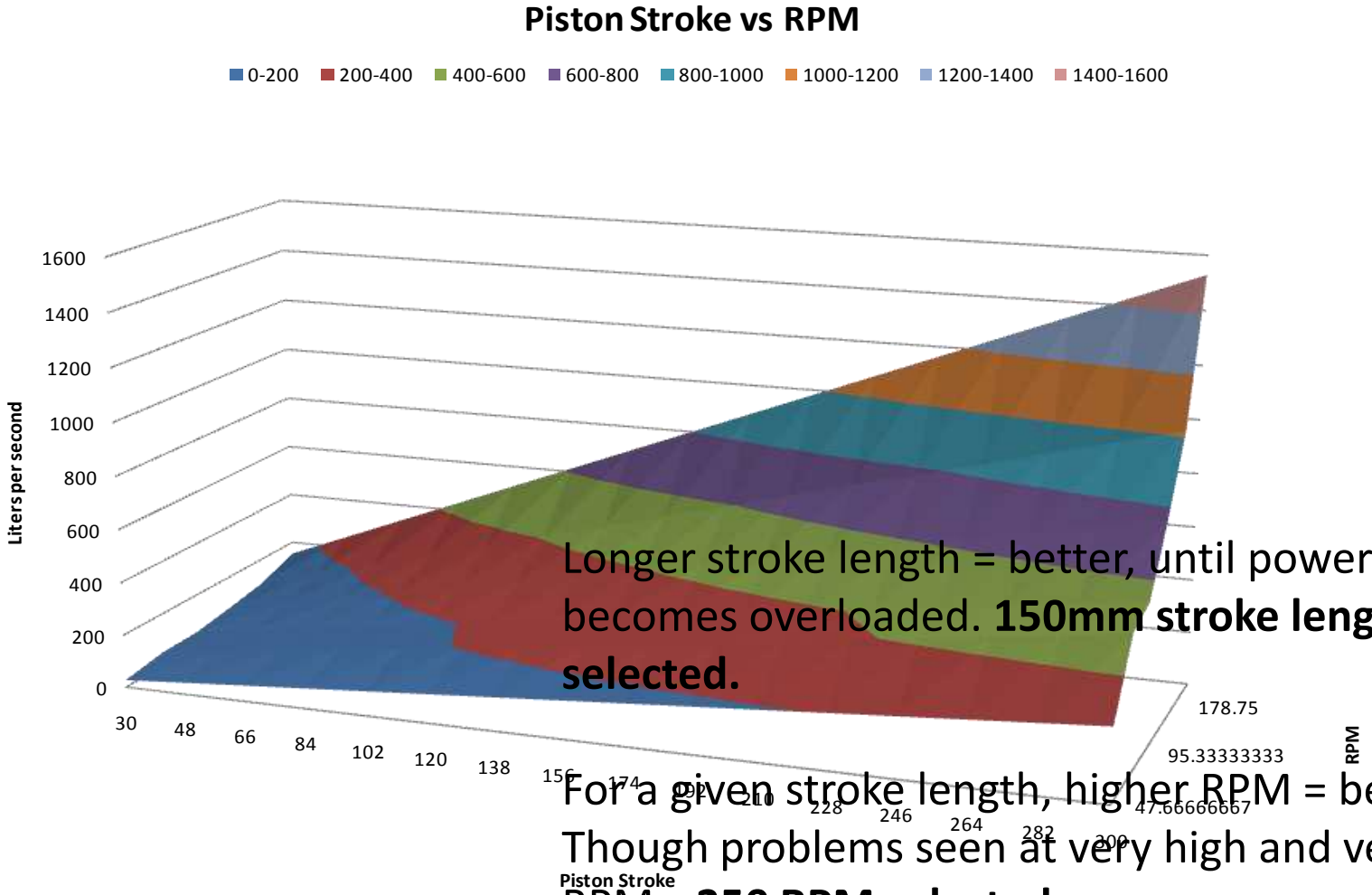
Nano Vac - Operation

‘Suck’

‘Blow’



Nano Vac – Test rig



Longer stroke length = better, until power source becomes overloaded. **150mm stroke length selected.**

For a given stroke length, higher RPM = better. Though problems seen at very high and very low RPMs. **250 RPM selected.**

Nano Vac – First prototype

- IC engine powered
- 80mm/800mm pulley system for speed reduction

Positive pressure = 6 BAR
Negative pressure = -0.8 BAR

- Tests on water were successful.

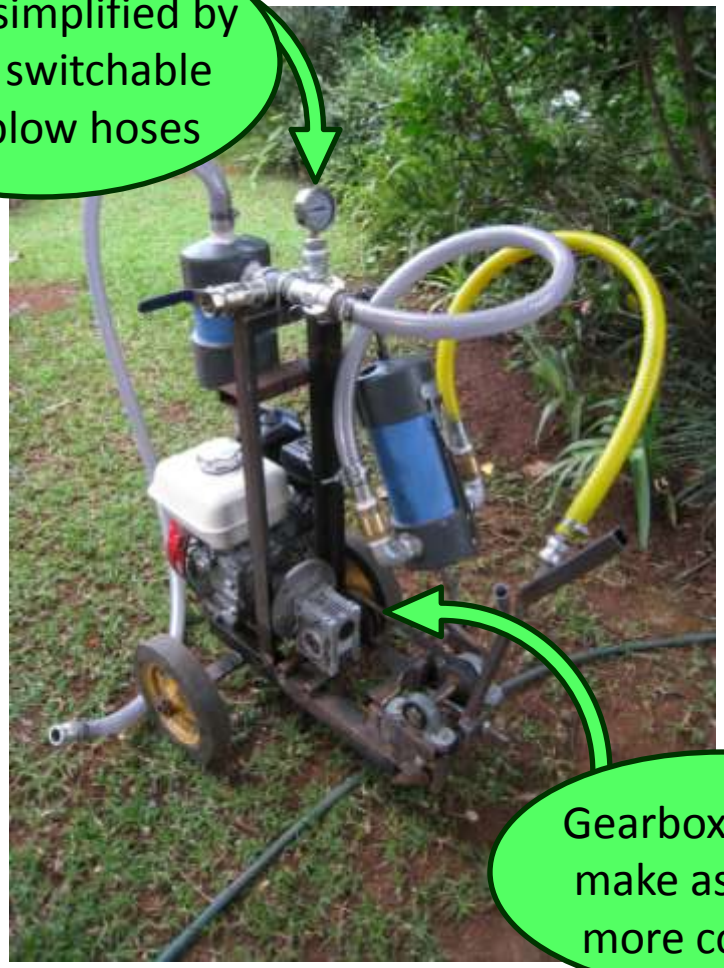
- Tests on pig waste caused higher vacuum pressures which lead to structural damage

Nano Vac – Second Prototype 1

Valving simplified by having switchable suck/blow hoses

Only one piston deemed necessary

Suck



Blow

Gearbox used to make assembly more compact

Nano Vac – Second Prototype 2

Positive pressure: 3 BAR
Negative pressure: -0.5 BAR

Reduced due to belt slip

Smaller pulleys
→ less contact area
→ belts slip more easily
→ need an additional drive belt?

Nanovac – final prototype

Nano Vac – Conclusion 1

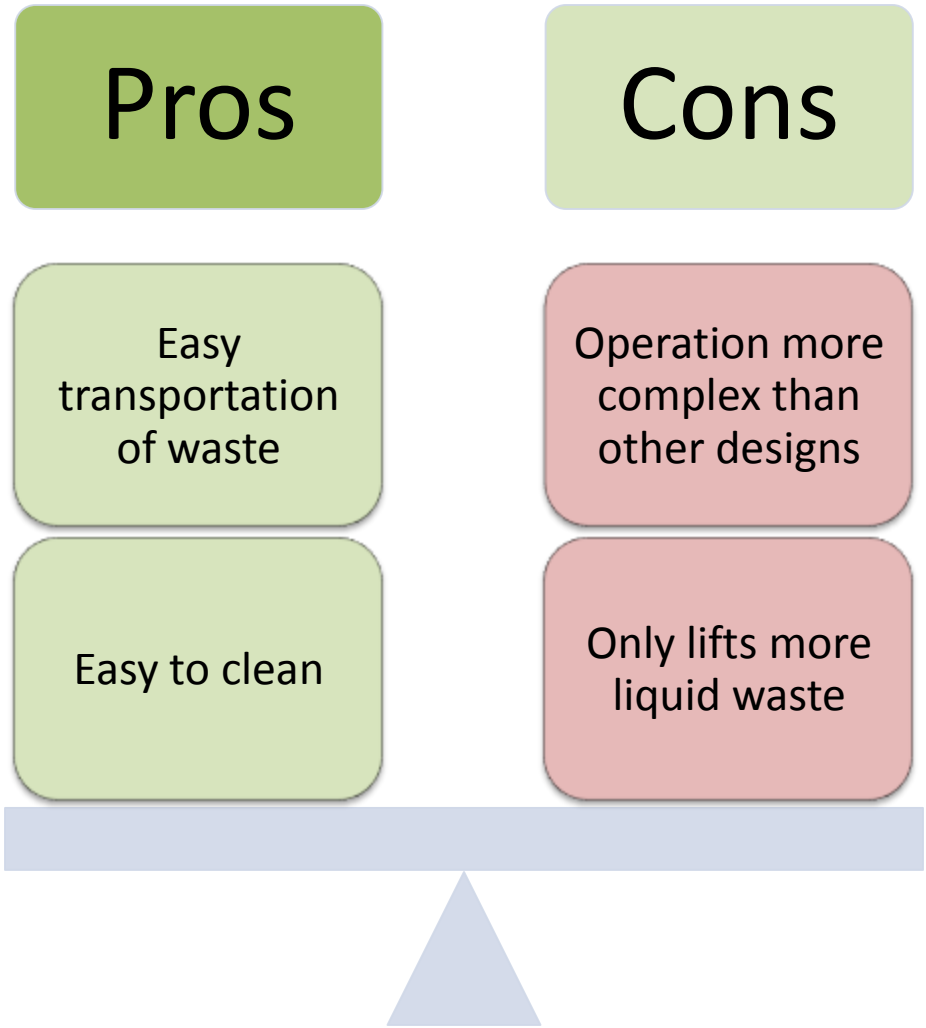
Looking promising, BUT...

...Prototype testing still in progress...

...May lead to design changes

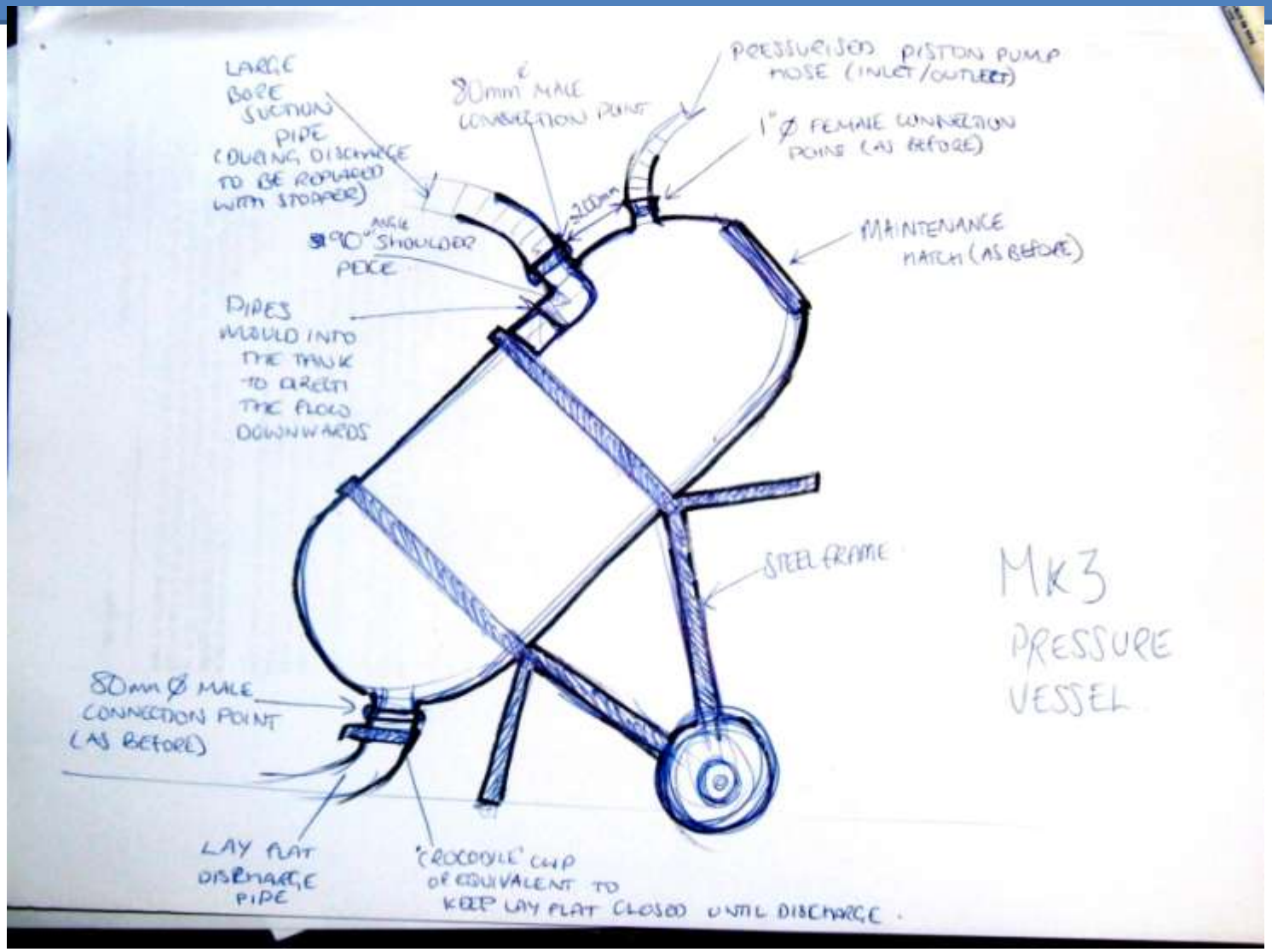
Total cost of final prototype: R9,000

Emptying rate: Still unknown



The eVac

The pressure vessel



The pressure vessel

But, **trash** is a major problem

Conclusion

More mobile SMME appropriate pit emptying technologies can be developed. The PSA and eVAC seem most promising at this stage, but until we can change the practice of using pits for solid waste disposal, manual emptying is going to be the only practical option.

Pour flush anyone?