# A 21st CENTURY ADVANCED SUSTAINABILITY WINERY

A teaching winery with advanced sustainability and winemaking technology is being built at the University of California.

The winery will be totally solar powered. Solar powered hydrogen fuel cells will produce hydrogen to power winery forklift trucks and provide electricity outside sunlight hours.

Winery water requirements will be met by rainwater treated by reverse osmosis and nano filtration. Water will be recovered and reused up to ten times.

# significant technology improvements

There are a number of significant technology improvements being considered. These include use of,

- Jameson Cells for white juice settling (reducing the time and energy costs for settling white juice compared to cold settling by 80 to 90% and likely to produce cleaner free run),
- A fluidised bed cold stabilisation cell (reducing cold stabilisation energy use by 80 to 90% and reducing processing time to 10%),

# significant technology improvements

- A protein stabilisation cell (reducing the use of bentonite),
- Mixing tubes and in-tank blending (fast efficient blending),
- CIP (Cleaning in place) and potassium base cleaning chemicals (reduced chemical use, reduced waste water production)

NOTE THE DIAGRAMS and GRAPHS IN THIS PRESENTATION ARE TAKEN DIRECTLY FROM PROFESSOR ROGER BOLTONS 3 DAY COURSE "THE CHEMICAL ENGINEERING OF SUSTAINABLE WINEMAKING" MELBOURNE UNIVERSITY DECEMBER 2013 AS IS MUCH OF THE WORDING

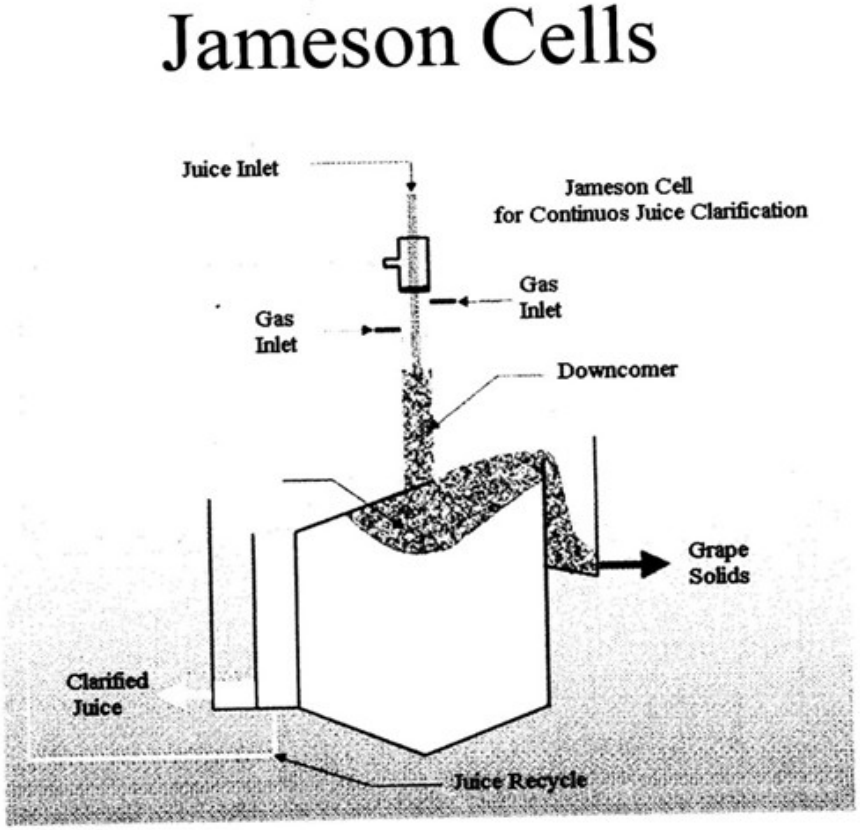
# THE JAMESON CELL

The Jameson Cell is an advanced Australian designed flotation cell. With some modification and trial work it will be suited to white juice settling. Compared to traditional cold settling it will reduce the time and energy costs for settling by 80 to 90% and is likely to produce cleaner free run juice.

# THE JAMESON CELL

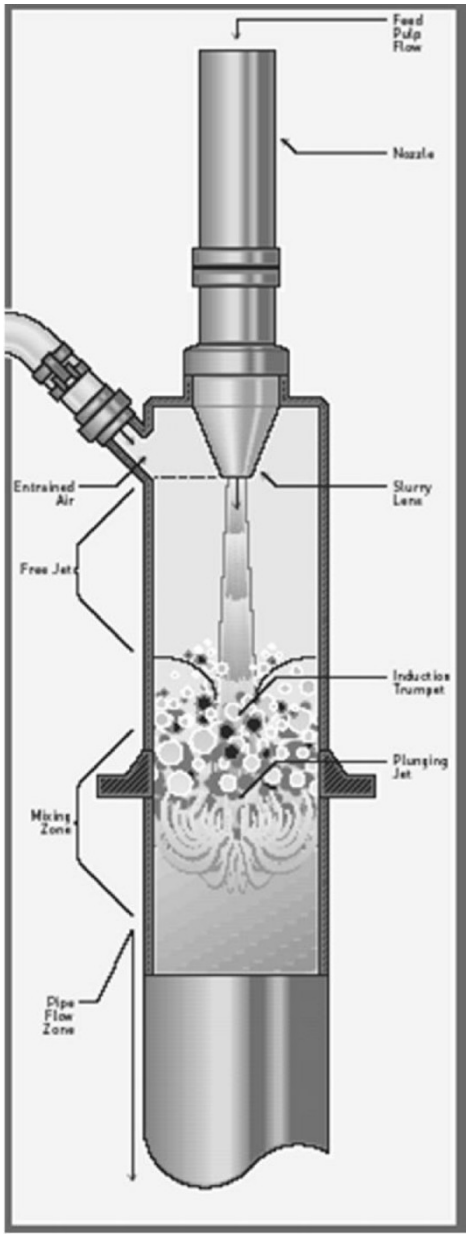
(There are over 200 Jameson Cell installations worldwide, approximately 100 in Australia, 77 in the Australian coal industry [between 1990 and 2011 Jameson Cells produced over $22.5 billion more export coal sales than the installations they replaced])

# THE JAMESON CELL



# THE JAMESON CELL

THE DOWNCOMER SHOWING THE FLUID NOZZLE AND THE ENTRAINED AIR ENTRY (OR NITROGEN ETC. FOR A WINE INDUSTRY JAMESON CELL)



# FLUIDISED BED COLD STABILISATION

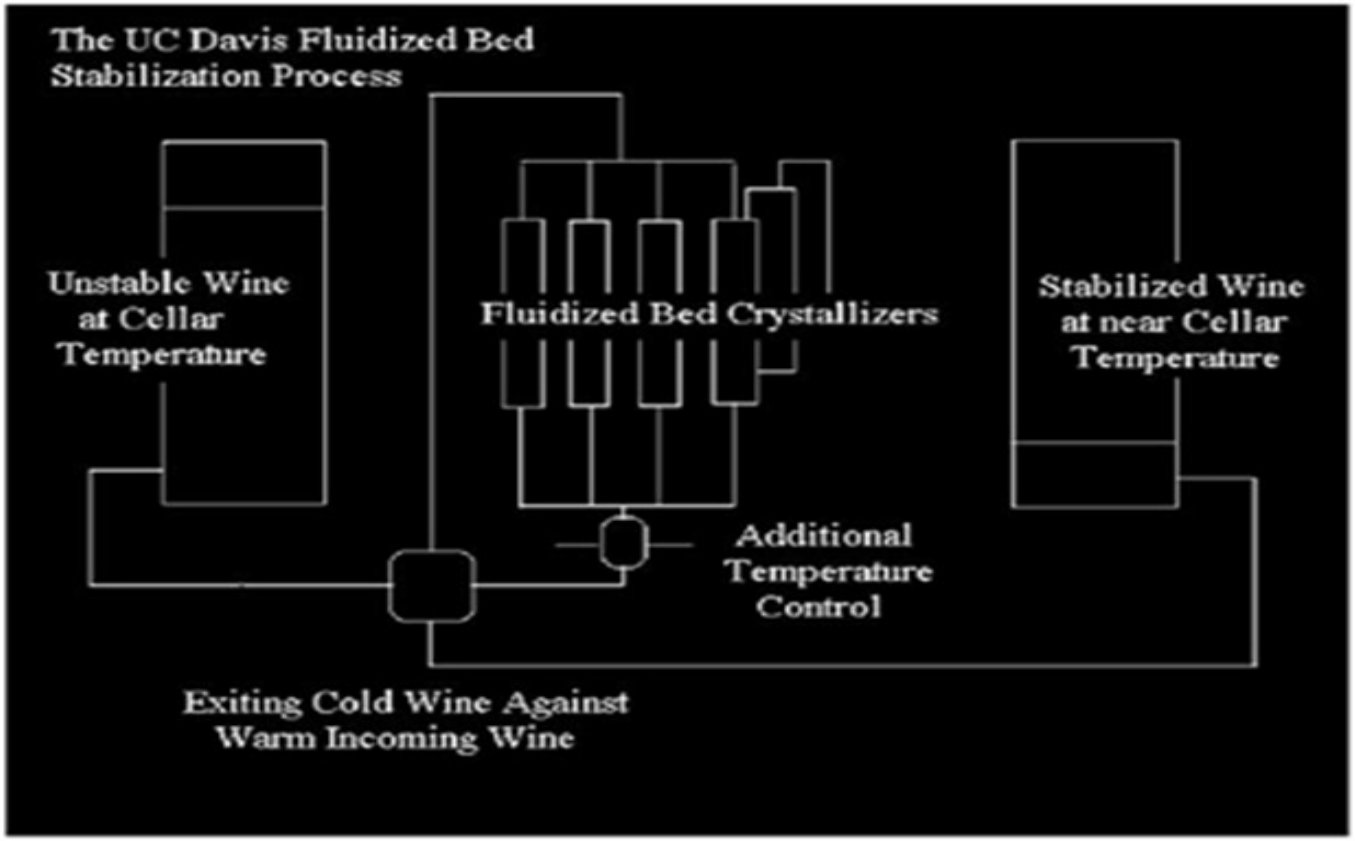
Fluidised bed cold stabilisation has not progressed beyond a laboratory test rig unit. However when trialled the test rig reduced the conductivity of the wine by 640μ S/cm and traditional cold stabilisation only reduced conductivity by 270μ S/cm."

The design uses a vertical column of large tartrate crystals through which wine to be stabilised is passed. The large tartrate crystals are "held suspended" by the wine and a fluidising gas both of which are passed vertically up through the column. These large crystals capture tartrate crystals in the wine as it flows past them. The wine leaves the fluid bed tartrate (or "cold") stabilised

# FLUIDISED BED COLD STABILISATION

- Professor Boulton anticipates the design will achieve an energy reduction of 90% compared to traditional cold stabilisation.
- This design needs to be further researched and developed to confirm whether it will meet the promise of high quality fast tartrate stabilisation with greatly reduced energy use.

# FLUIDISED BED COLD STABILISATION



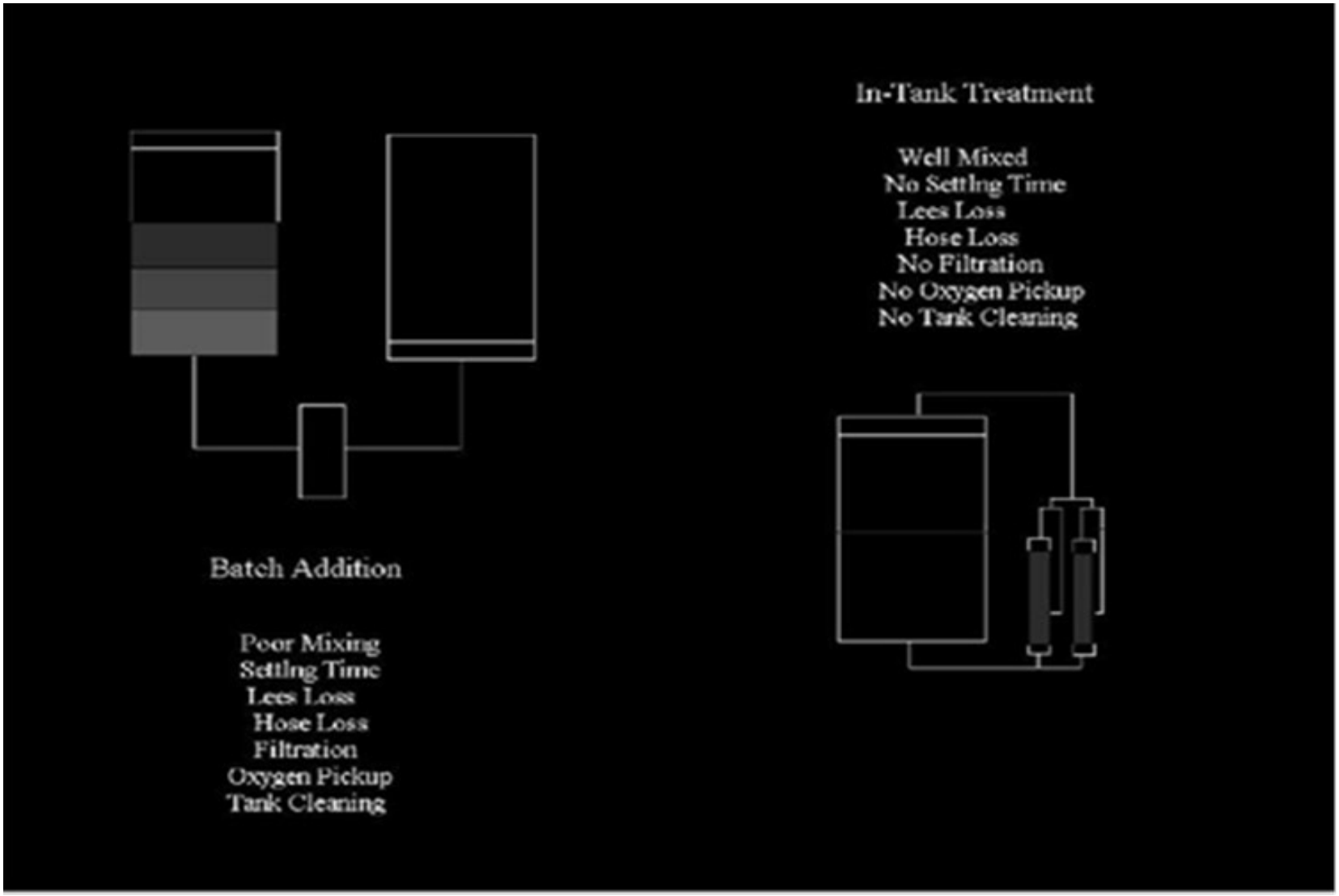
# PROTIEN STABILISATION CELL

This technology uses a vertical column of Macroprep 50 S to treat wine to achieve Protein Stability (and to eliminate a use of bentonite and to save water)

# MACROPREP 50 S

- Fuller details internet UC DAVIS RAVE 2009 video “Replacement of Bentonite, Emphasis on Flavour Retention”
- Granular Ceramic cation exchange material
- Capacity about 35% of Na+ Bentonite
- Regeneratable with dilute acid solution
- Useful Life yet to be established
- Eliminates Bentonites, Filtration & Tank Cleaning

# PROTIEN STABILISATION CELL



# IN-TANK BLENDING

In-tank blending involves a portable trolley with in-line static mixers and flow meters with associated piping and control valves and associated pumps. This design,

- Avoids a Blending tank
- Mixes fractions efficiently using static mixers
- Returns blend to original tanks by Layering
- Saves water from tank cleaning
- Avoids oxygen pickup
- Saves several tank transfers

# In-Line Static Mixers

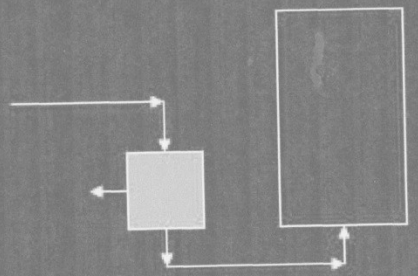
# CIP (CLEANING IN PLACE)

# (WITH POTASSIUM BASED CLEANING CHEMICALS)

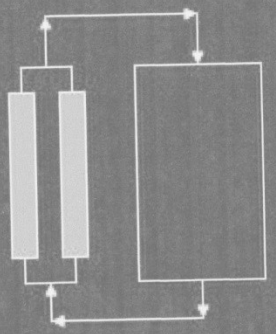
The aims with a winery CIP installation with potassium based cleaning chemicals are to,

- Reduce winery water use from an average of 1 to 1½ litres of water per litre of wine to below .3 litres of water per litre of wine,
- To recirculate and reuse caustic and acid cleaning agents until they are ‘fully spent’ (minimising chemical use and minimising the cost of chemicals),

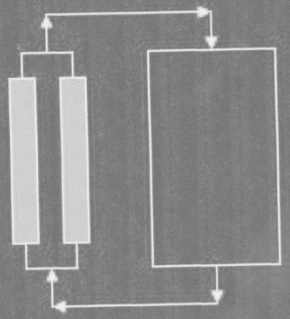
# 4 Examples of Avoiding a Tank Cleaning



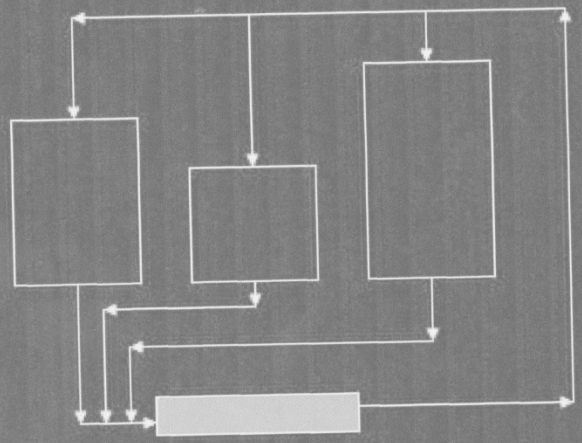
Jameson Flotation Cell



MacroPrep Protein Adsorption Column



KHTa Fluidized Bed



In-Tank Blending

# CIP (CLEANING IN PLACE) (WITH POTASSIUM BASED CLEANING CHEMICALS)

- Minimise the production of winery waste water and produce waste water that requires less treatment per litre,
- Improve Sustainability by producing waste water that has less impact on the land it is being discharged onto,

# CIP (CLEANING IN PLACE)

# (WITH POTASSIUM BASED CLEANING CHEMICALS)

Professor Boulton advocates using KOH and KHSO4 for wine caustic and acid cleaning respectively. When mixed the spent acid and caustic produce a ‘mild’ K2SO4 salt solution.

# CIP (CLEANING IN PLACE)

# (WITH POTASSIUM BASED CLEANING CHEMICALS)

Potassium vs Sodium for plants and soils

- Most plants have uptake systems for both
- Preference is between 10 to 100 fold in favour of Potassium
- Sodium generally considered toxic at moderate levels

# CIP (CLEANING IN PLACE)

## (WITH POTASSIUM BASED CLEANING CHEMICALS)

Chloride, Phosphate, Nitrate, Sulphate for plants and soil

- Chlorosis of plants
- Phosphate -Algal growth in ponds, streams
- Groundwater “nitrification”
- Low to medium levels Sulphate are taken up by the vines

# CIP (CLEANING IN PLACE)

# (WITH POTASSIUM BASED CLEANING CHEMICALS)

Sulphate vs Citrate/Citric Acid.

- Sulphate is inorganic and has no BOD associated with it.
- 1% w/v Citric Acid has a BOD of 7,496 mg/g

# CIP INFORMATION FOR DAVIS UNIVERSITY TEACHING WINERY

Reverse Osmosis –Nano Filtration CIP Water System

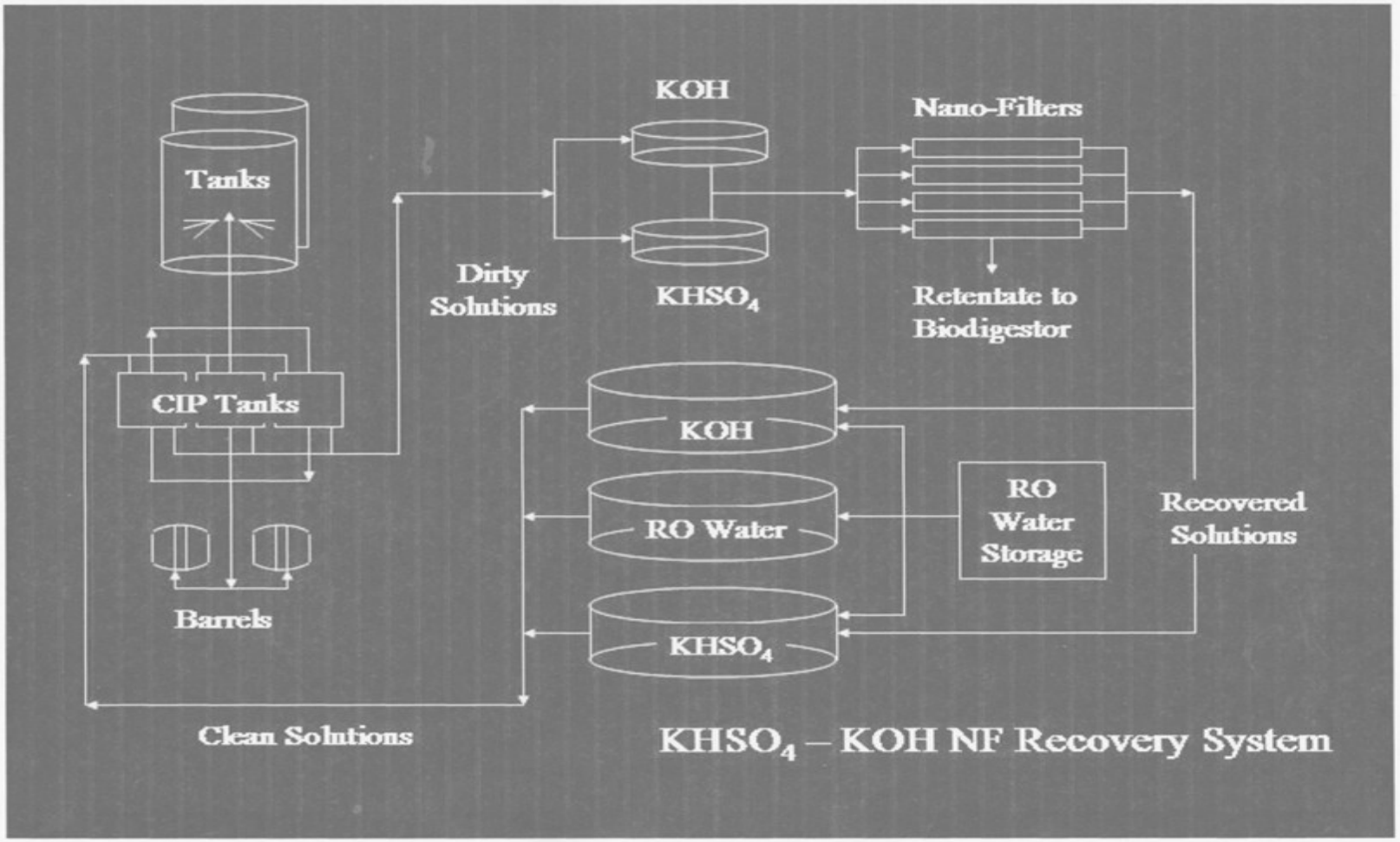
- Soft Water Supply
- – Rain Water Capture from RMI Building
- – RO Water Storage Tank
- CIP Solution Storage Tanks, and Return Tanks

# CIP INFORMATION FOR DAVIS UNIVERSITY TEACHING WINERY

RO-NF CIP Water System

- Captured CIP Solutions re-filtered on NF
- – 5 to 10% makeup RO Water
- – Retentate with organics (5 to 10%) to UC Biodigestor
- Water requirement of 1/5th to 1/10th conventional practices

# CIP INFORMATION FOR DAVIS UNIVERSITY TEACHING WINERY



# FURTHER DETAILS

Further detailed information is given in “The Chemical Engineering of Sustainable Winemaking”- a three day course by Professor Boulton University of Melbourne, in December 2013

More general discussion is included in “Designing Wineries for Sustainable Practices”- Roger Boulton – International Conference – EcoSostenible Wine, Forum Berger Balguer, Vilafranca del Penedes, 27/11/2008.

# FURTHER DETAILS

Further general detail in

“UC DAVIS EXPERIMENTAL SUPER WINERY HAS OPENED ITS DOORS FOR BUSINESS”, L. Cutler, Australian & New Zealand Grapegrowers and Winemakers Magazine, June 2014

# CONCLUSION

The introduction of

- Jameson Cells for white juice settling
- Fluidised bed cold stabilisation
- Protein stabilisation using MacroPrep 50 S
- Mixing tubes for blending
- CIP and potassium base cleaning chemicals

To Australian wineries will improve both sustainability and profitability by reducing Energy use, Water use, Chemical use and Waste water generation and save time and labour

# CONCLUSION

The author’s assessment is these technologies in the hands of skilled, practical winemakers will also lead to improvements in wine quality

# CONCLUSION

NOTE THE DIAGRAMS and GRAPHS IN THIS PRESENTATION ARE TAKEN DIRECTLY FROM PROFESSOR ROGER BOLTONS TRAINING COURSE AS IS MUCH OF THE WORDING