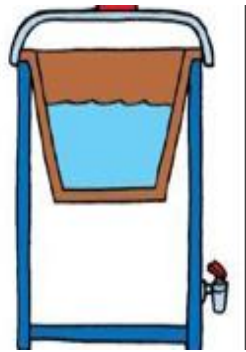


Investigation of the Critical Parameters in the Production of Ceramic Water Filters



Isabelle Gensburger
October 2011

A research executed by:



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Project Objectives

1. To better understand the production components and variables and move towards an **international certification programme**
2. To investigate ways to **increase the flow rate without compromising the water quality and strength of the filter**

Research Scope

Set up and test the research production line



Test reproducibility of RDI filters by mimicking RDI processes from mixing to firing



Experiment with variations

1. Rice husk quantity (9.7, 11, 12, 13 and 14 kg)
2. Maximum firing temperature (685, 800, 885 and 950 deg. C.)
3. Rice husk particle size (<1 and 0.5<mm<1)

Research Production Line



- Water supply
- Electricity supply
- Raw materials
- Equipment

- Machinery:
 - Mixer
 - Hydraulic press



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Research Kiln

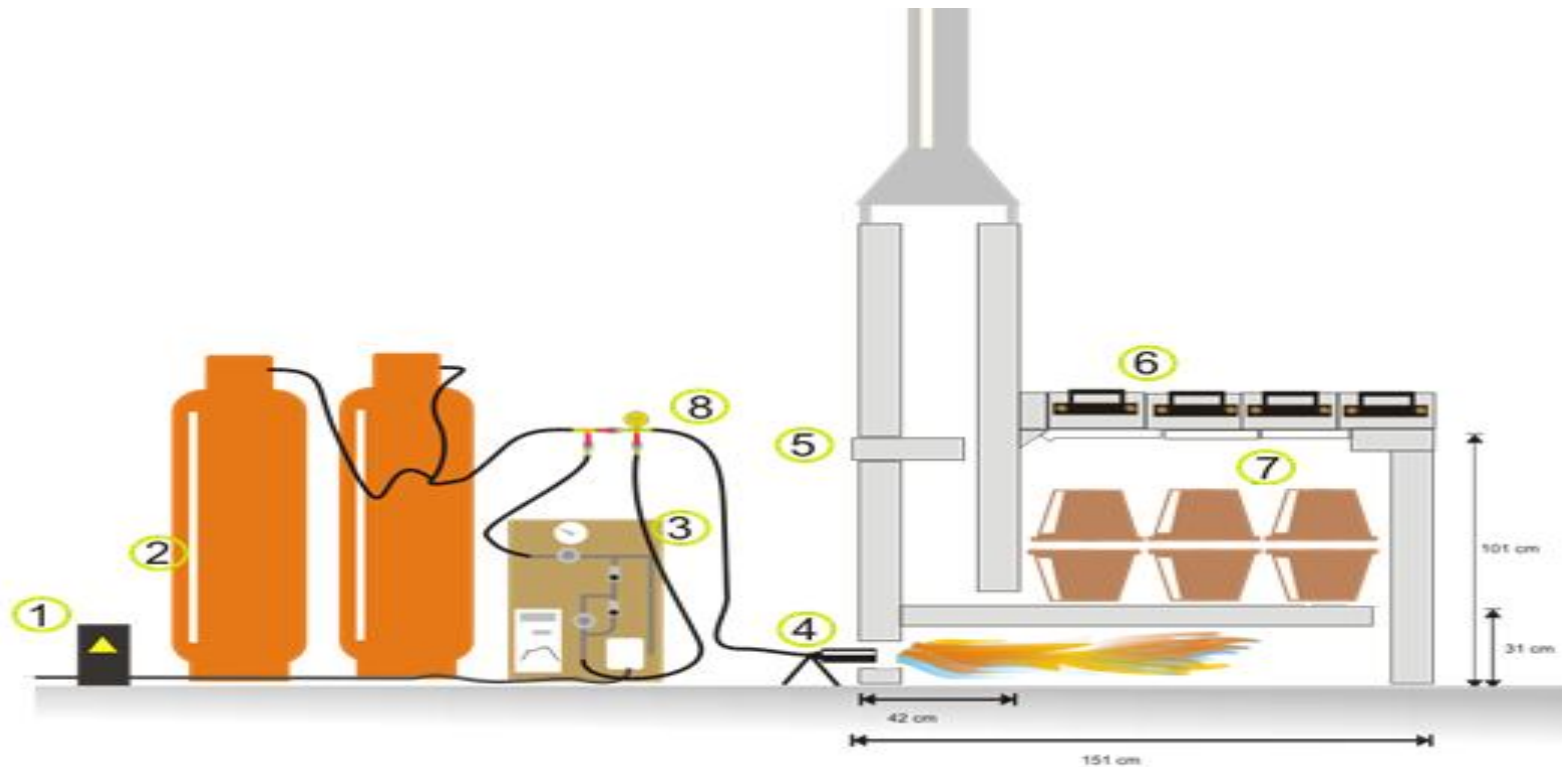


Figure 1

1. Power stabilizer
2. Gas bottles
3. Regulating system attached to wooden board
4. Burners
5. Chimney regulator
6. Roof parts
7. Internal floor.
8. Switch manual-automatic regulation.

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Methods: Filter Making Process

1. Preparation of raw materials (sieving < 1 mm)
2. Mixing of clay components (10 mins dry and 15 mins wet)
3. Forming of clay cubes for pressing
4. Pressing of clay cubes into ceramic filter form
5. Surface finishing and labeling of pressed filters
6. Drying of pressed filter elements (dry versus wet season)
7. Firing and cooling in kiln



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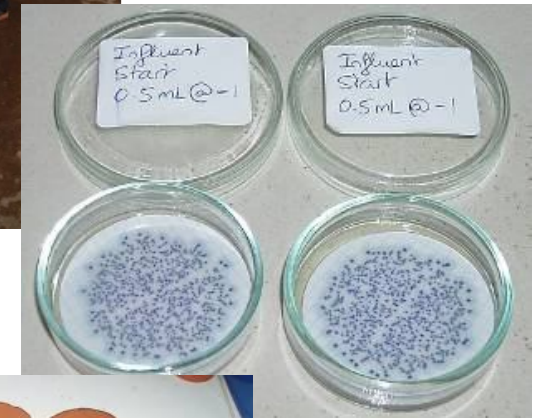
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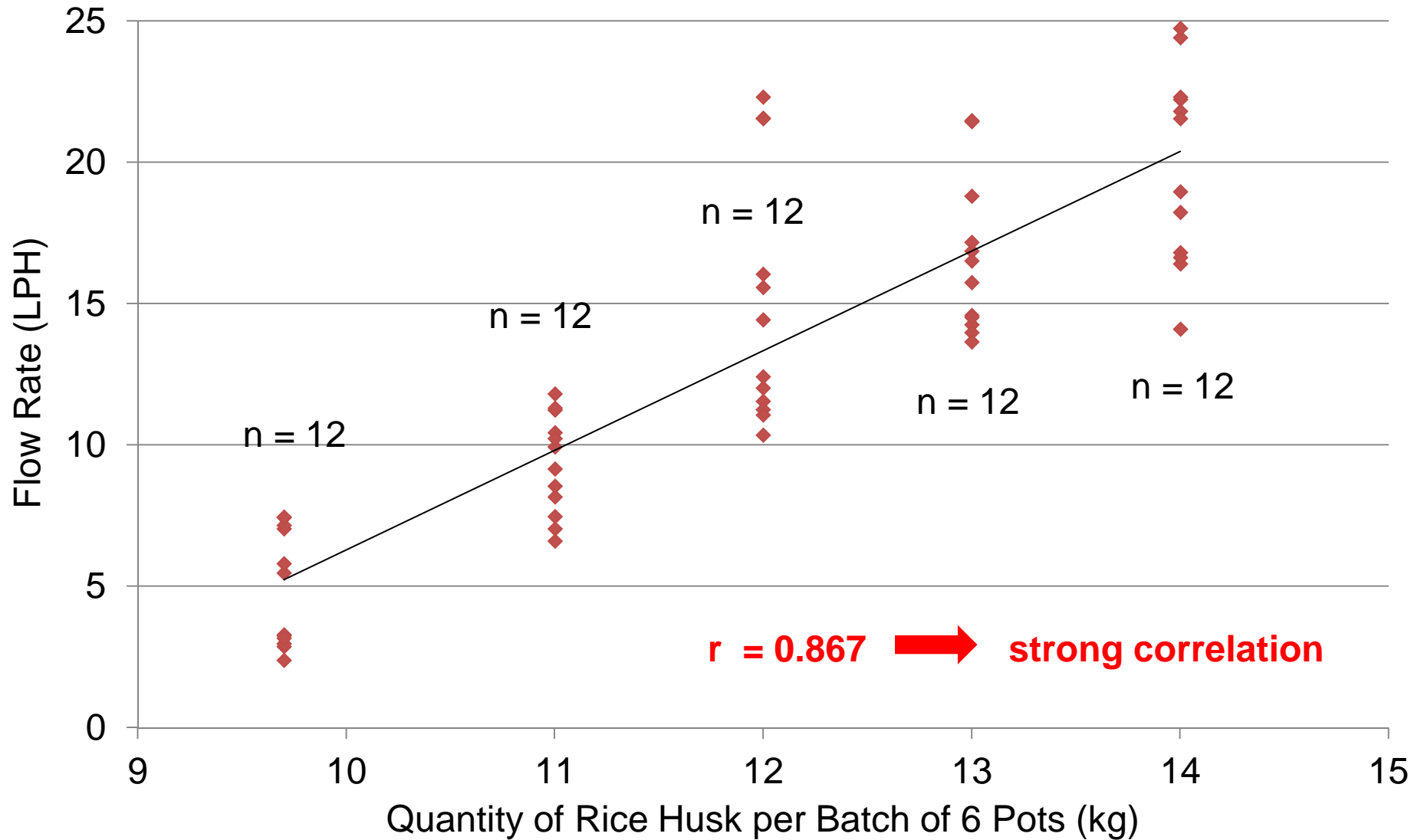
Methods: Filter Testing

- **Flow rate**
 - constant head method
 - long-term testing
- **E. coli**
 - indicator of bacteria
 - membrane filtration method
 - spiked influent water:
 - 10^3 CFU/ml without silver
 - 10^6 CFU/ml with silver
- **Strength**
 - discs cut from the bottom of the filters
 - modulus of rupture (MOR)
- **Pore size** (to be done at TU Delft)
 - mercury intrusion porosimetry



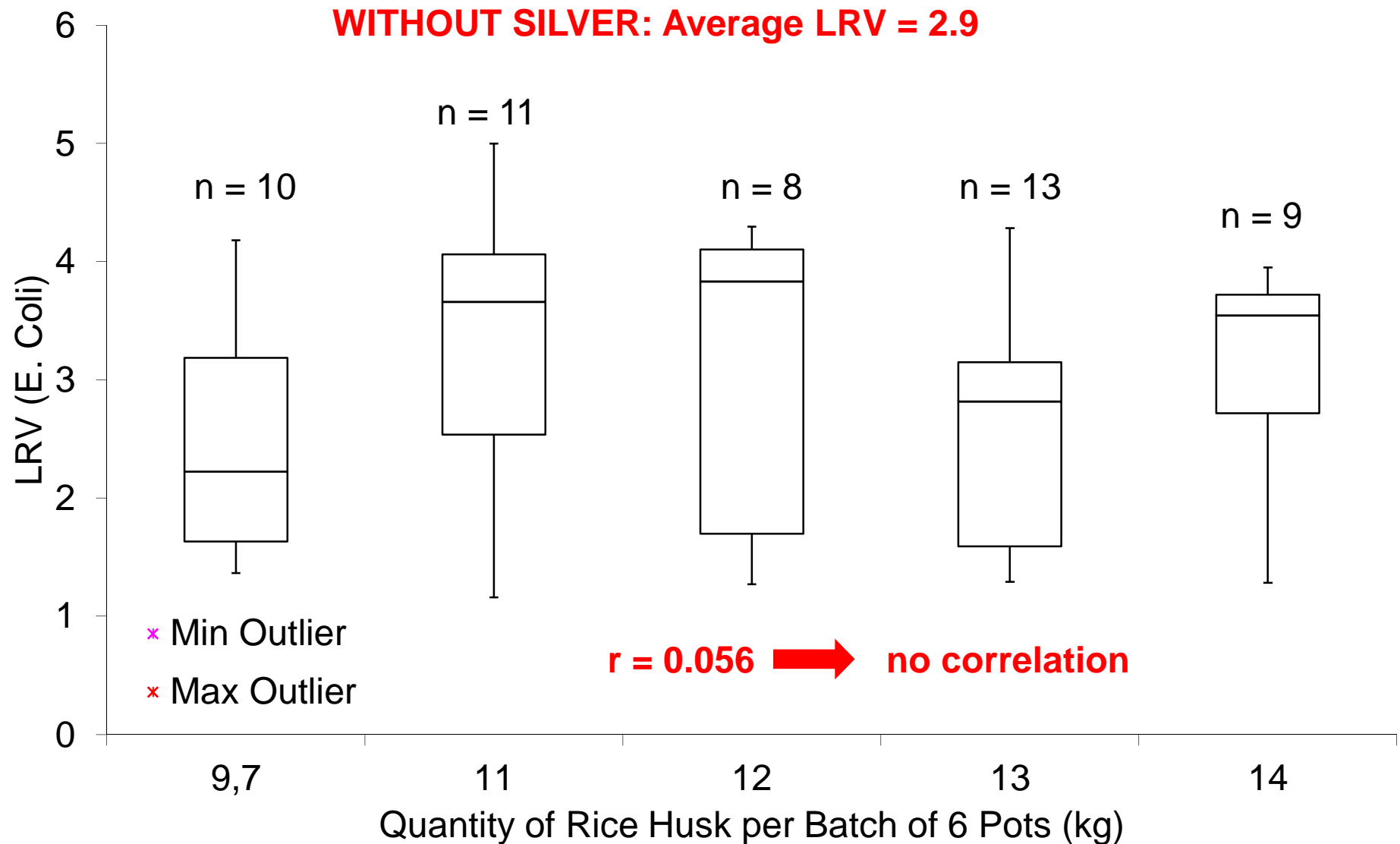
Variable: Rice Husk Quantity

Comparison: Flow Rate and Rice Husk Quantity



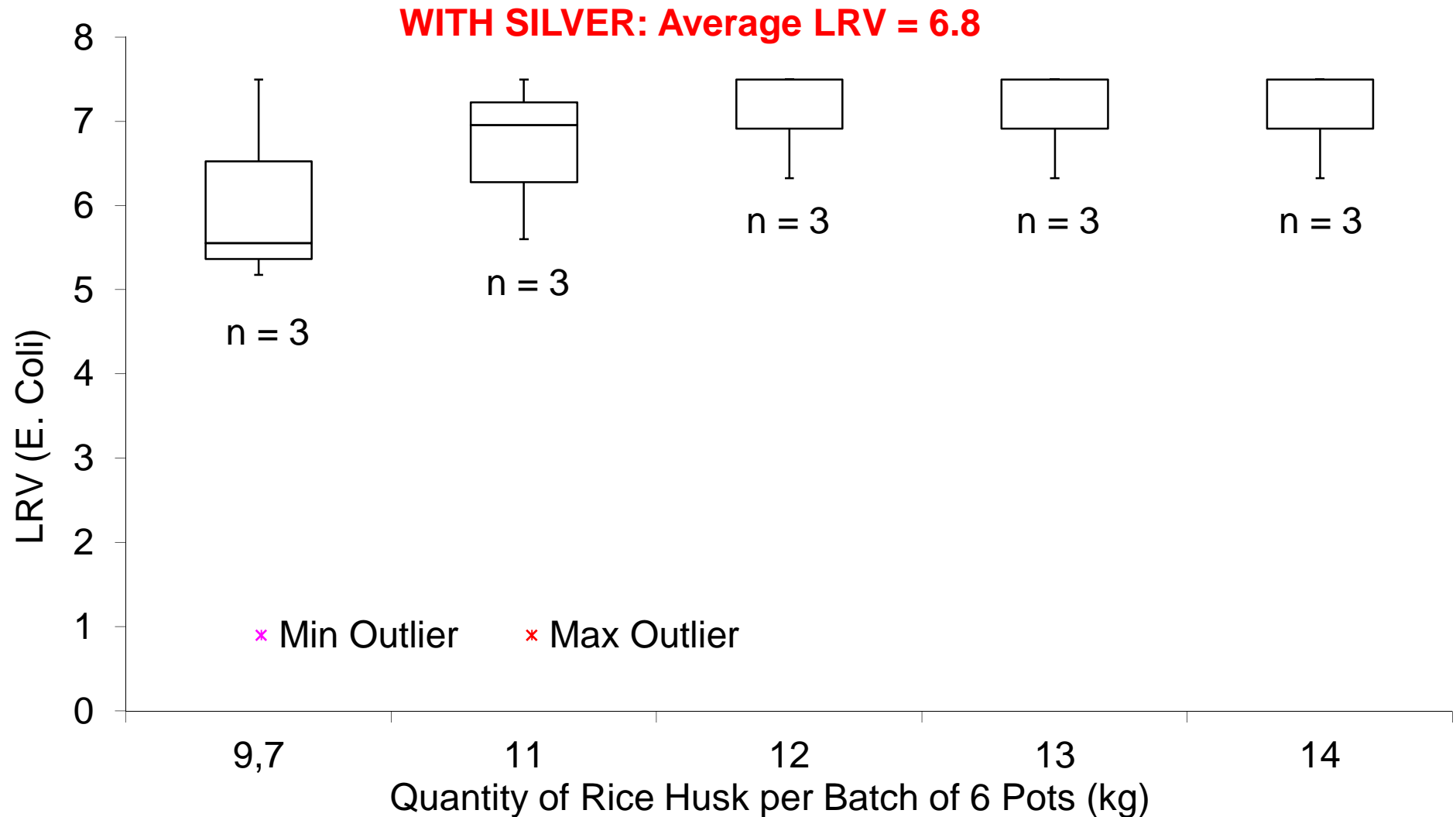
Variable: Rice Husk Quantity

Comparison: LRV and Rice Husk Quantity



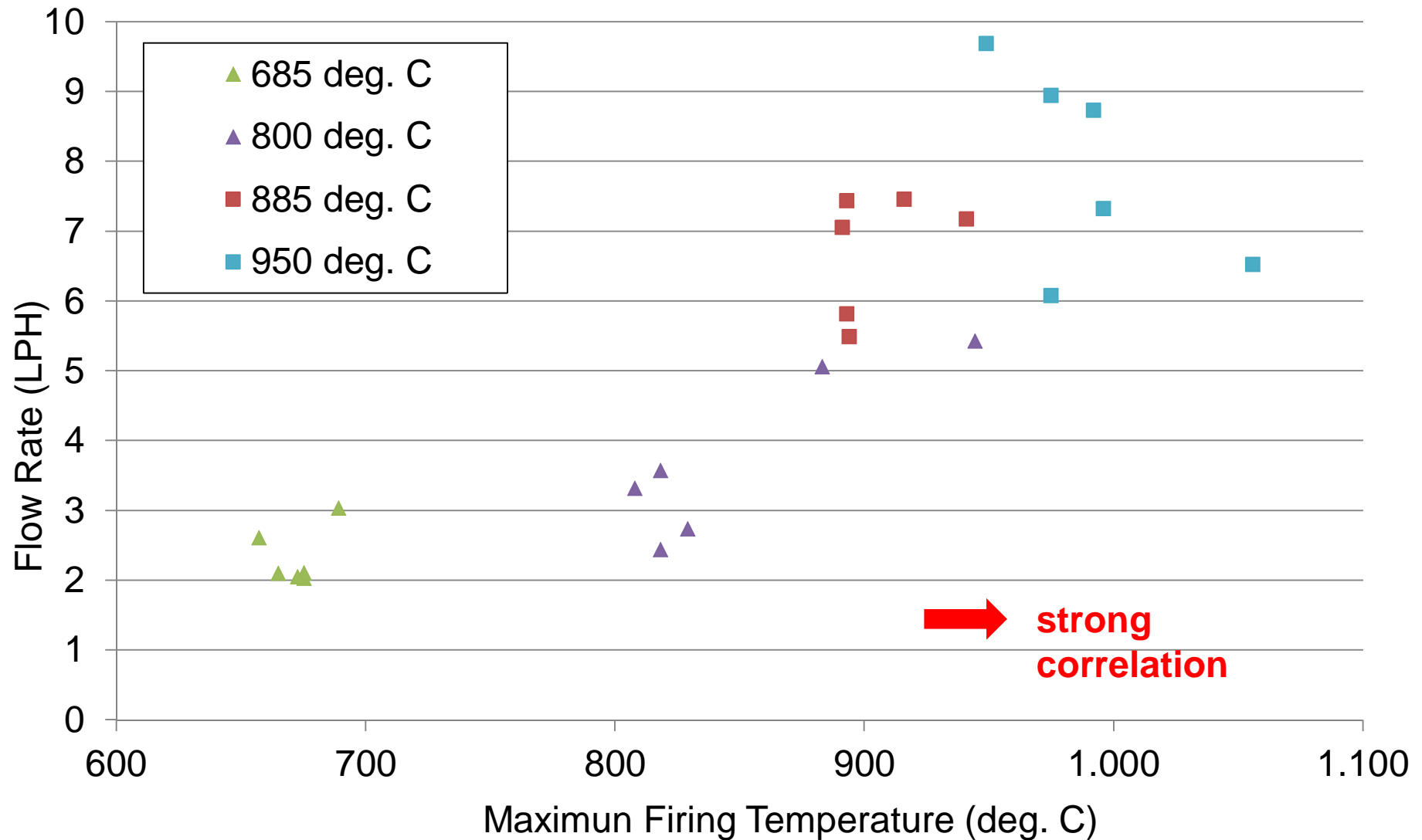
Variable: Rice Husk Quantity + Silver Nitrate

Comparison: LRV and Rice Husk Quantity



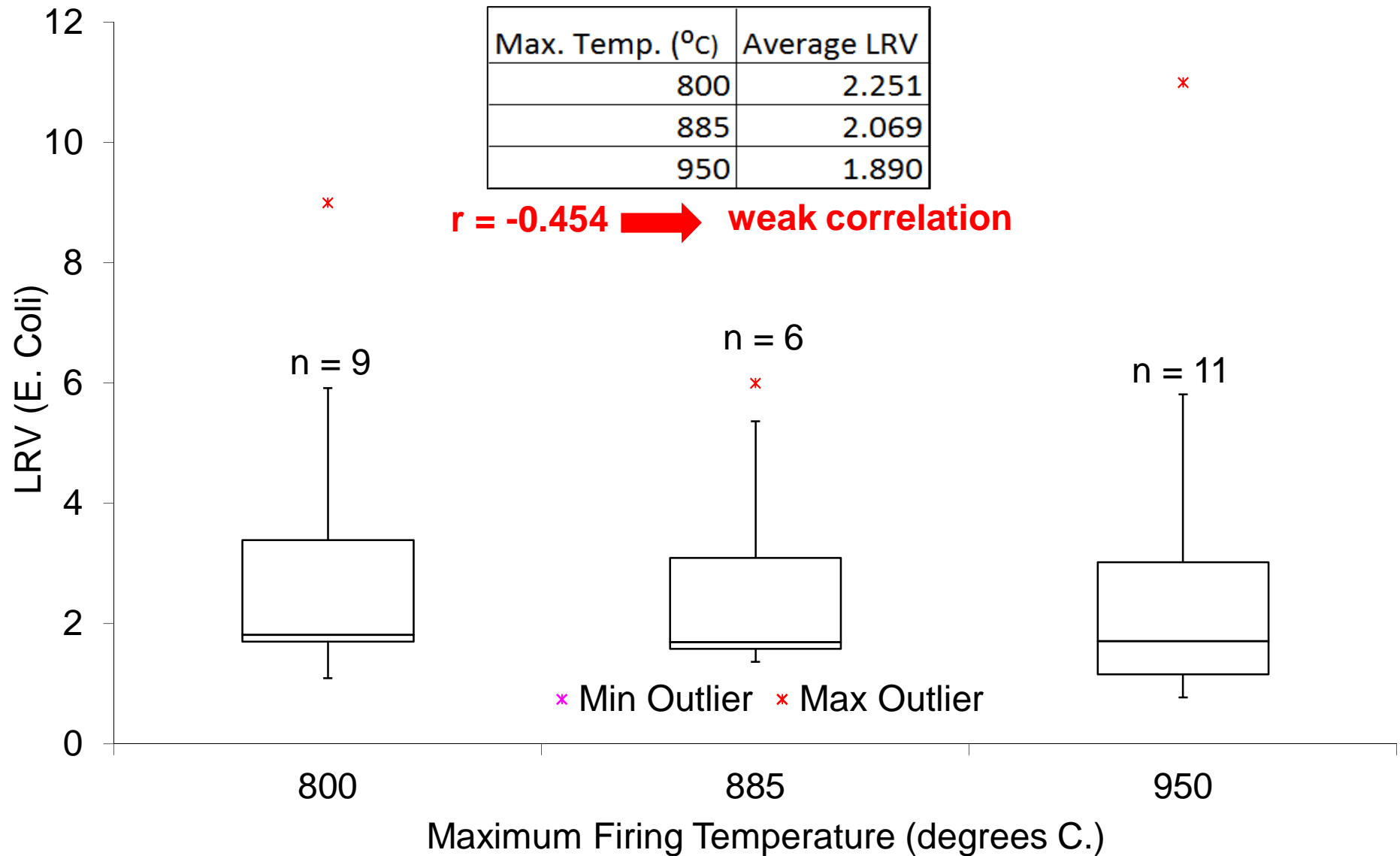
Variable: Maximum Firing Temperature

Comparison: Flow Rate and Max. Firing Temperature



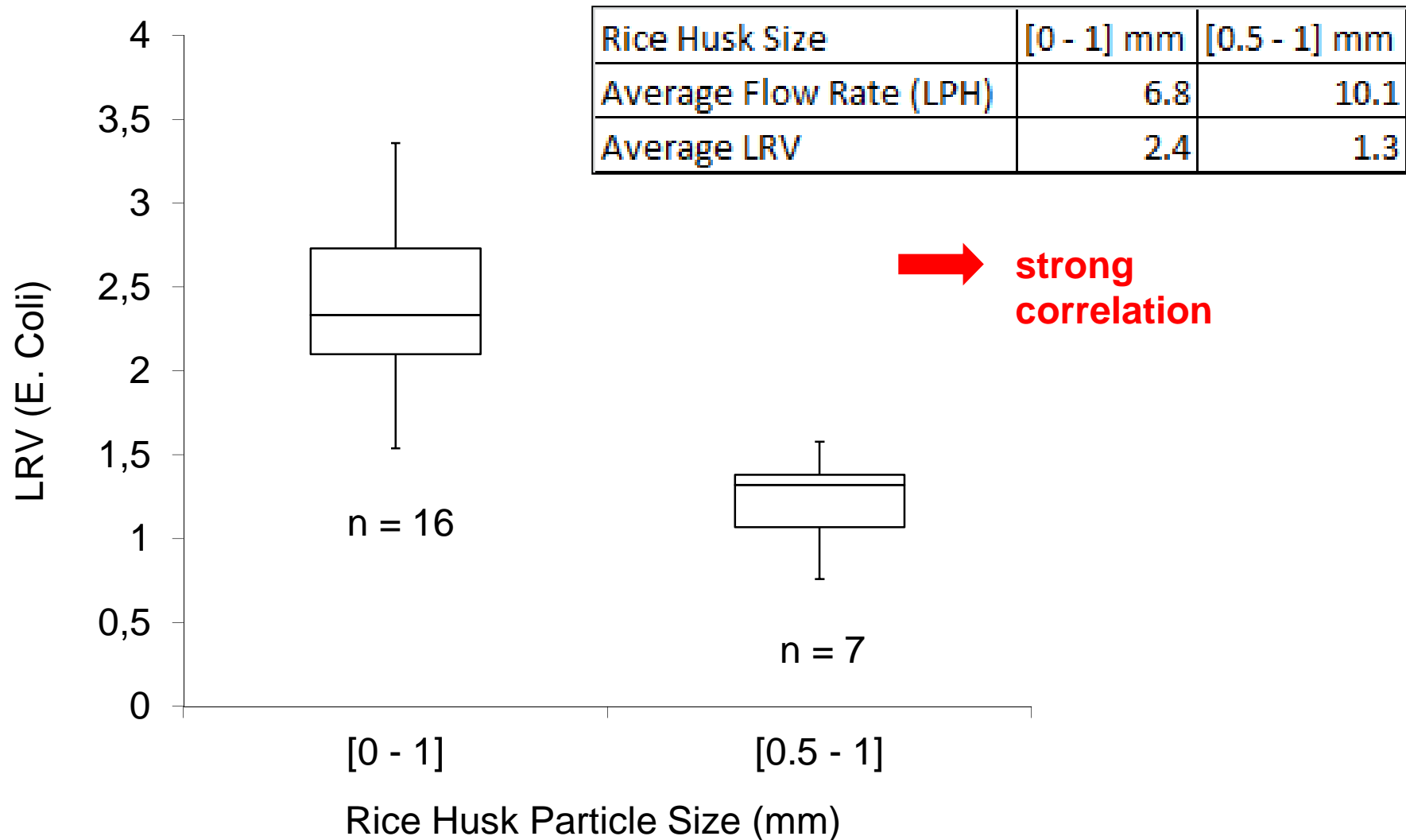
Variable: Maximum Firing Temperature

Comparison: LRV and Max. Firing Temp.



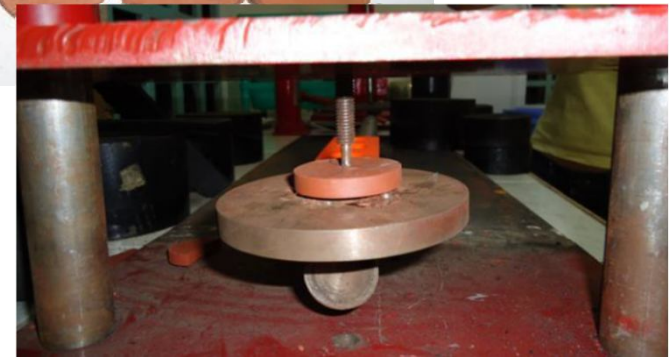
Variable: Rice Husk Particle Size

Comparison: LRV and Rice Husk Size



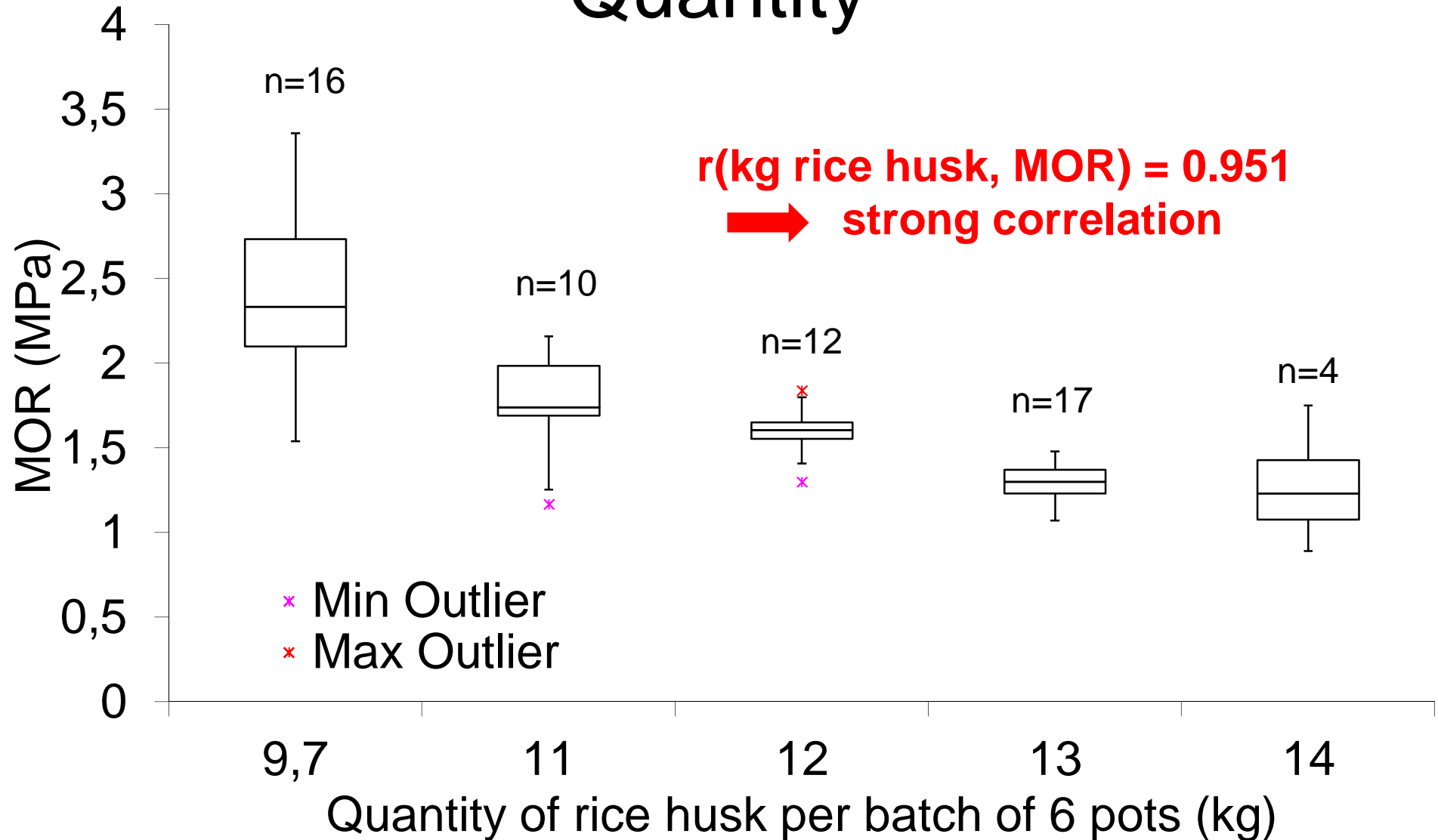
RESULTS

Strength Test



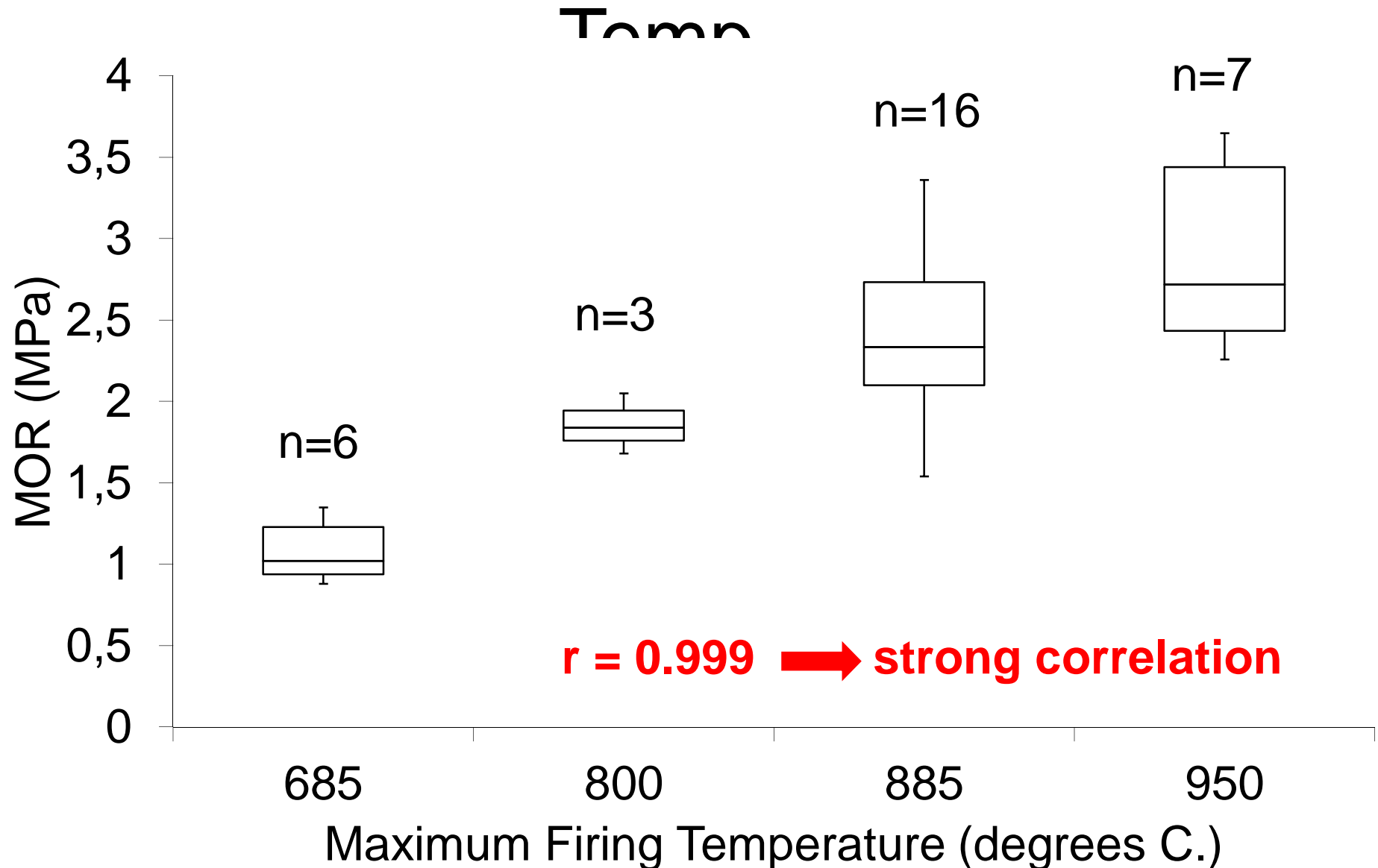
Variable: Rice Husk Quantity

Comparison: MOR and Rice Husk Quantity



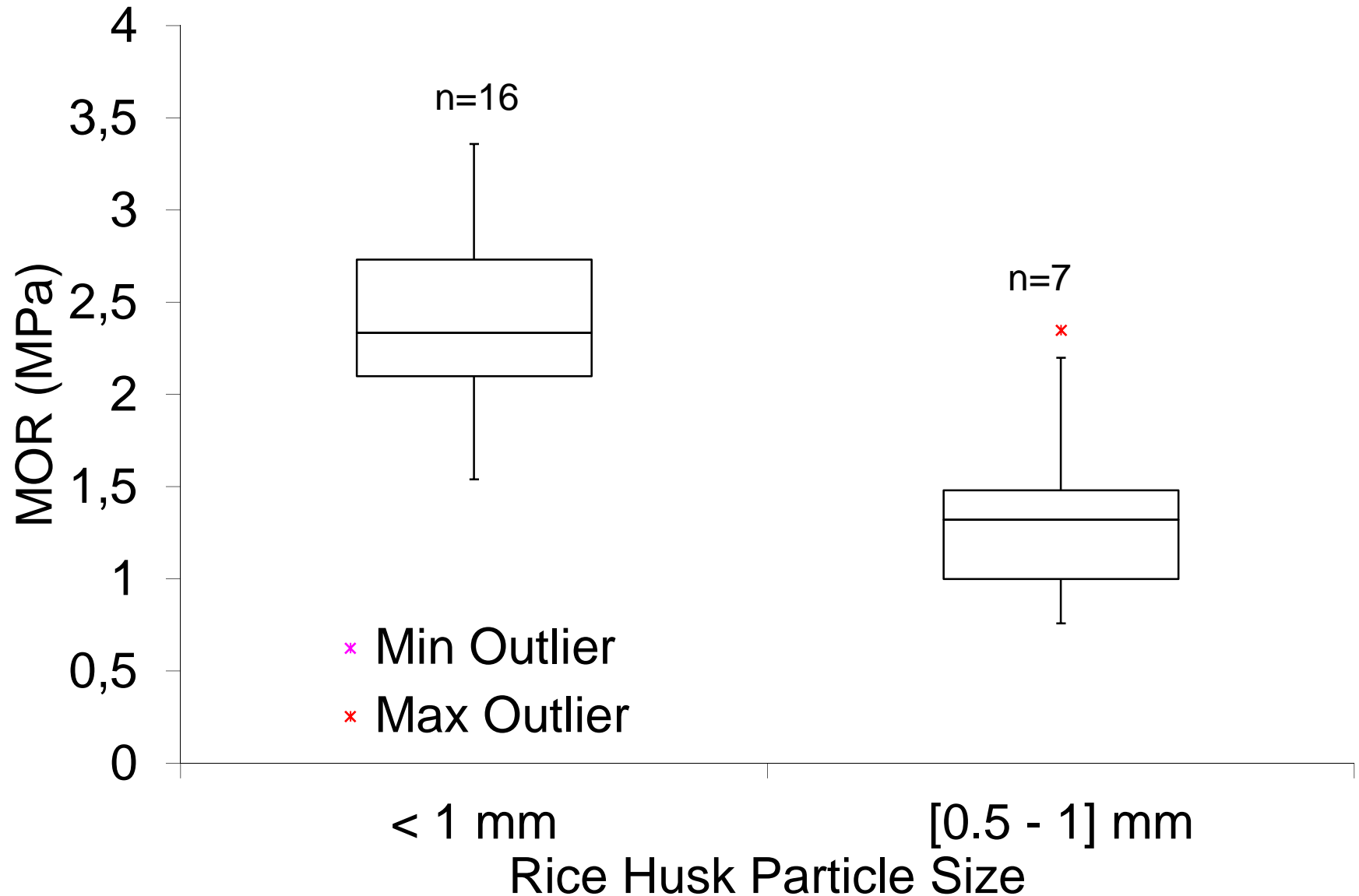
Variable: Maximum Firing Temperature

Comparison: MOR and Max. Firing



variable. RICE HUSK PARTICLE SIZE

Comparison: MOR and Rice Husk Size



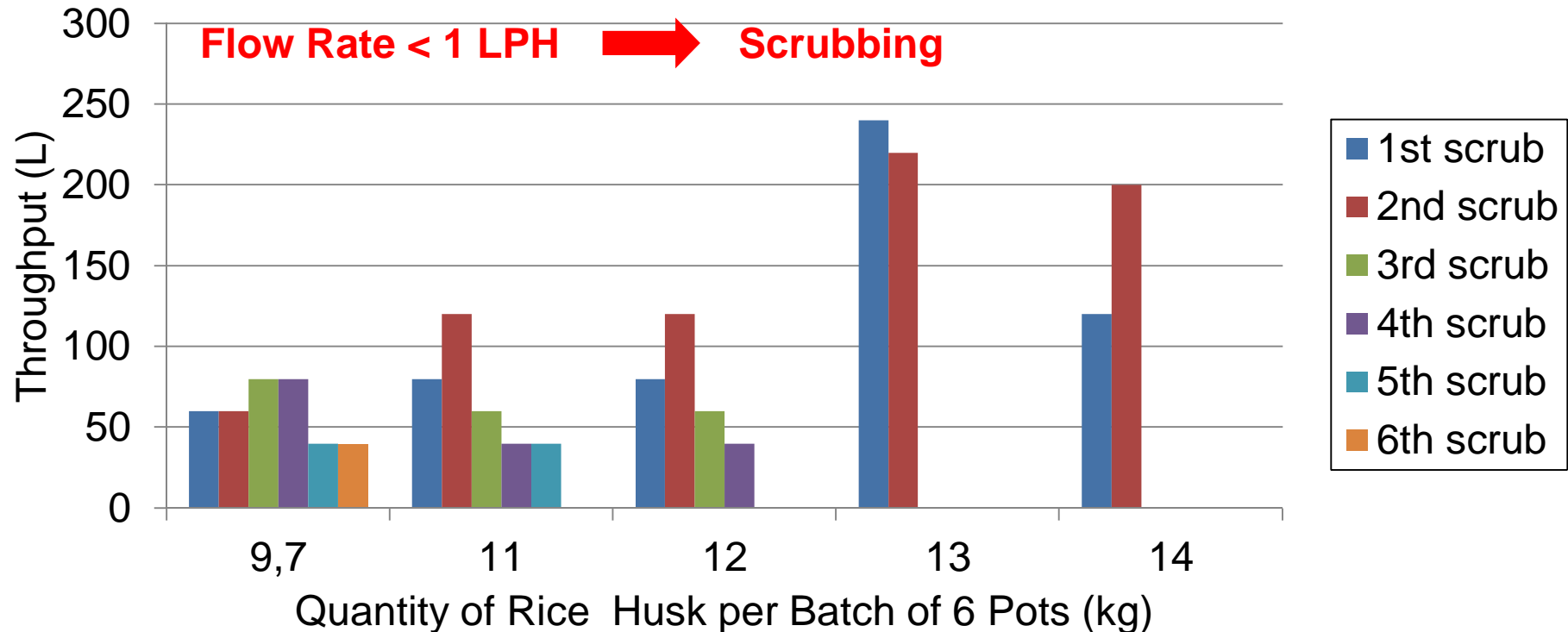
RESULTS

Long-Term Flow Rate Test



Long-Term Flow Rate Test

using turbid pond water ($12.9 < \text{NTU} < 199$)



When using less turbid well water ($2.7 < \text{NTU} < 27.1$):

- Pots (9.7 – 11 kg) already < 2 LPH
- Pots (12 – 13 kg) maintained flow rates > 2 LPH and only had to be scrubbed 2 times in the month
- Pots (14 kg) always maintained flow rates > 2 LPH throughout the whole month

Conclusions & Recommendations



a) Standard pot with standard pores and standard porosity



b) Pot with a higher porosity but the same pore size. The flow rate is doubled compared to a)



c) pot with the same porosity but an increased pore size. The flow rate is higher than a)

The flow rate can be increased by:

1. **increasing the porosity** of the filter, by increasing the quantity of burn-out material in the clay mix; and
2. **increasing the pore size**, either by
 - changing the particle size distribution of the burnout material, or by
 - changing the maximum firing temperature.

The bacteria removal effectiveness is only compromised when increasing the pore size

Thanks

Everybody at RDIC
My EWB colleagues
The Dutch Research Group



Questions?

