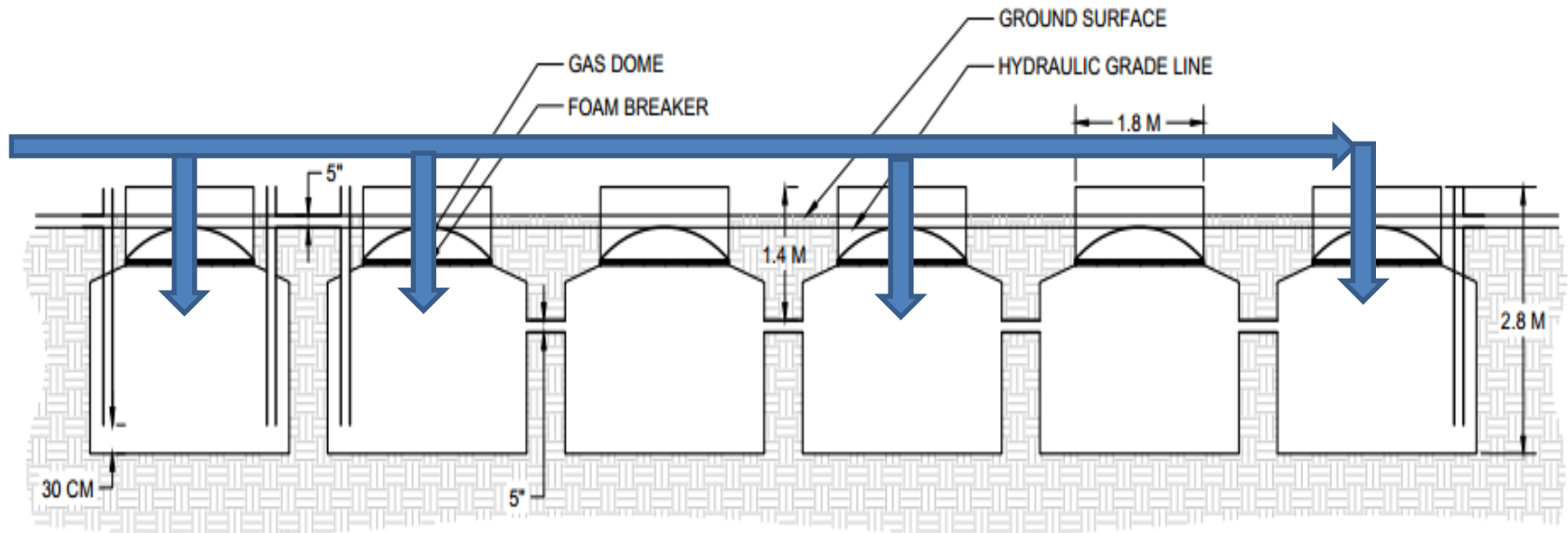


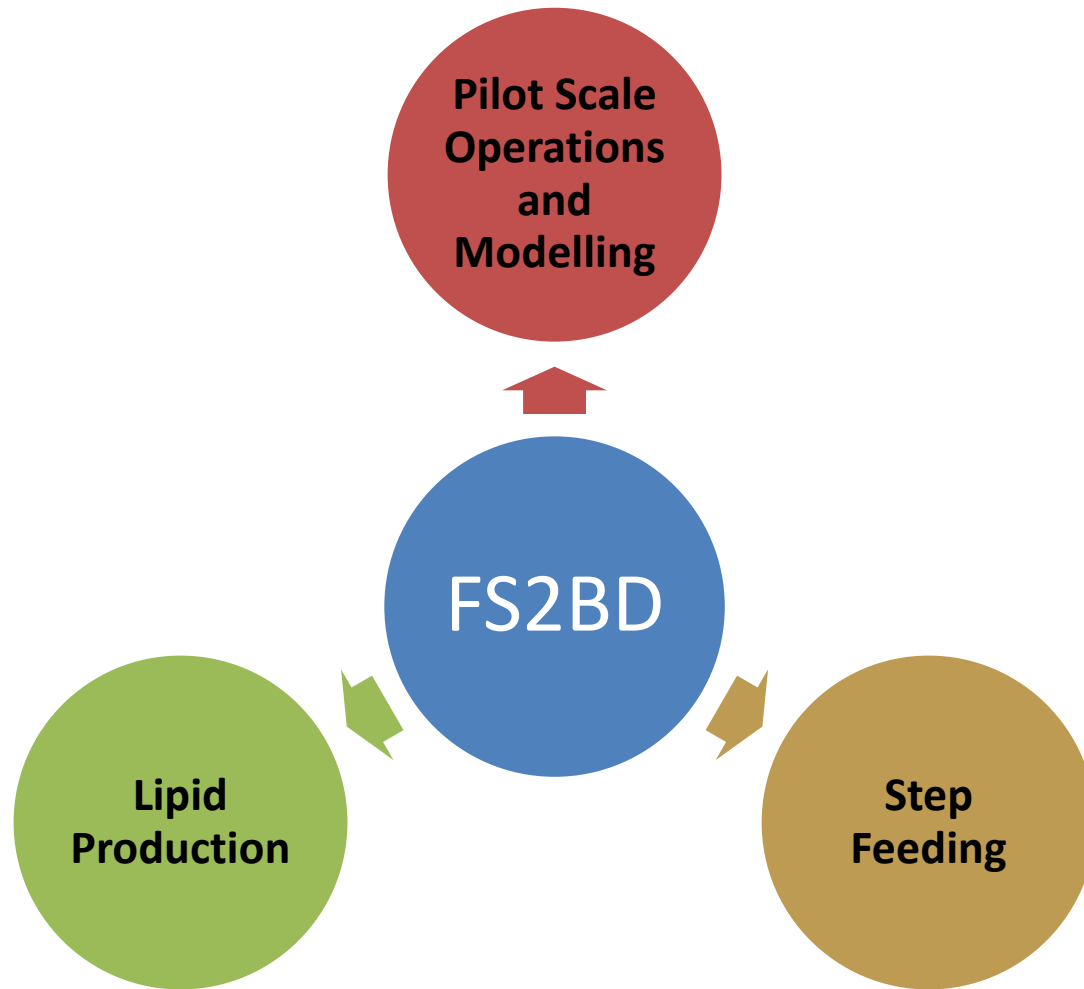


Step Feed Anaerobic Fermentation- A Novel Alternate for Faecal Sludge (FS) Processing

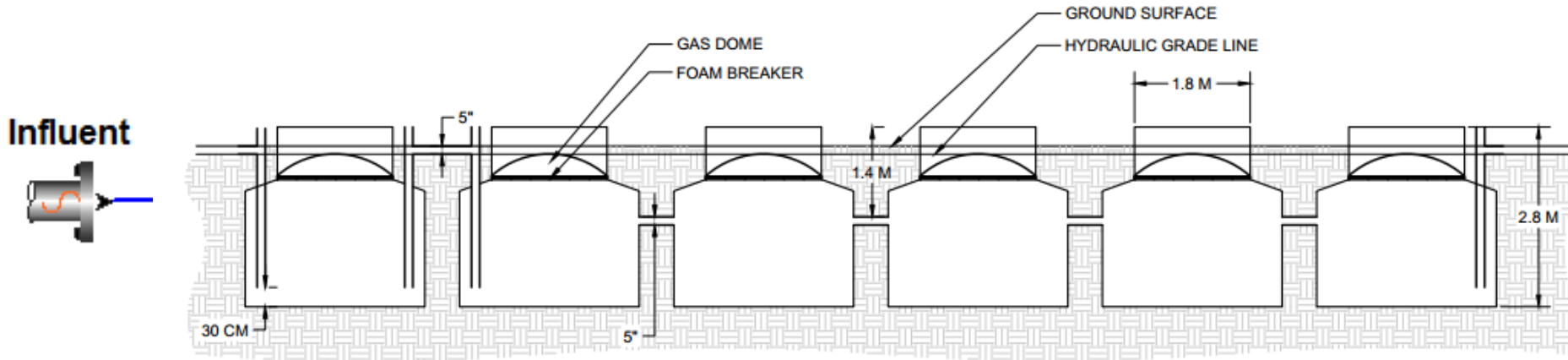


Ato Fanyin – Martin, Edris Taher, Kartik Chandran

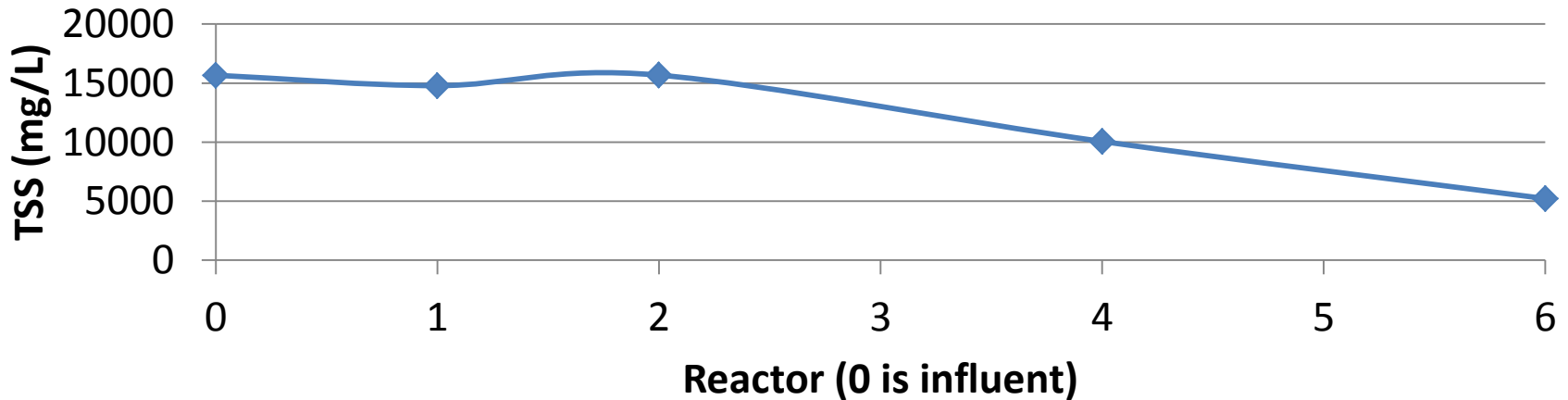
Faecal Sludge to Biodiesel Project



Settling Distribution in Reactors

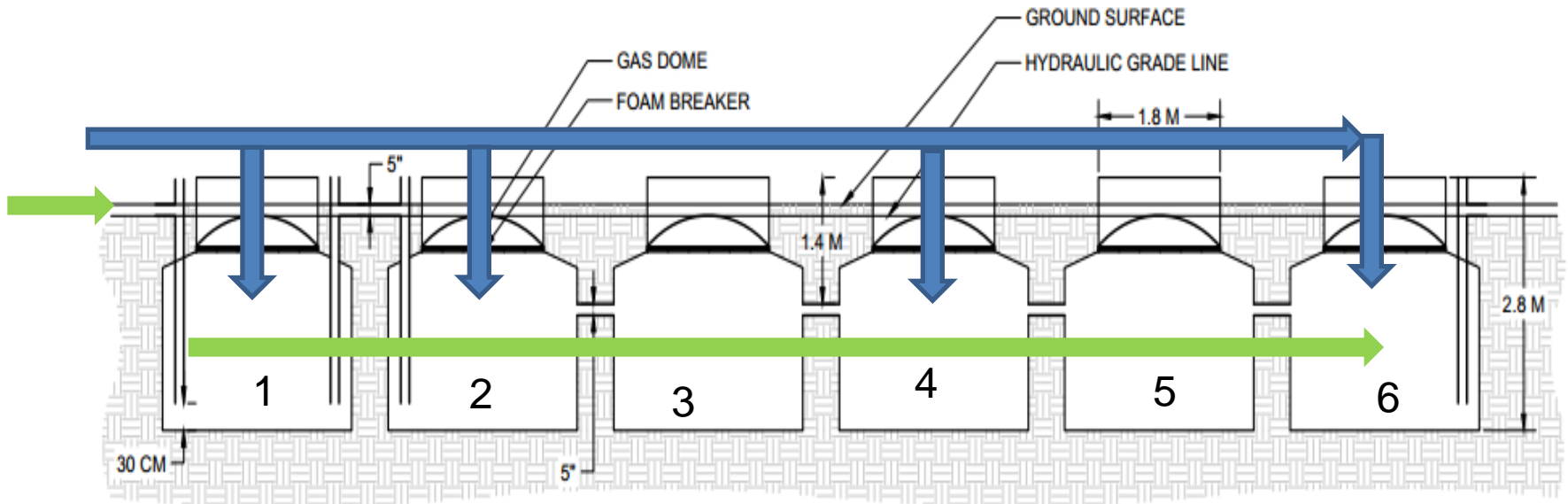


Total Suspended Solids (Period One and Two)



Step Feeding

The step-feed is the stepwise introduction of influent into the treatment plant at several passes (or stages) along its length



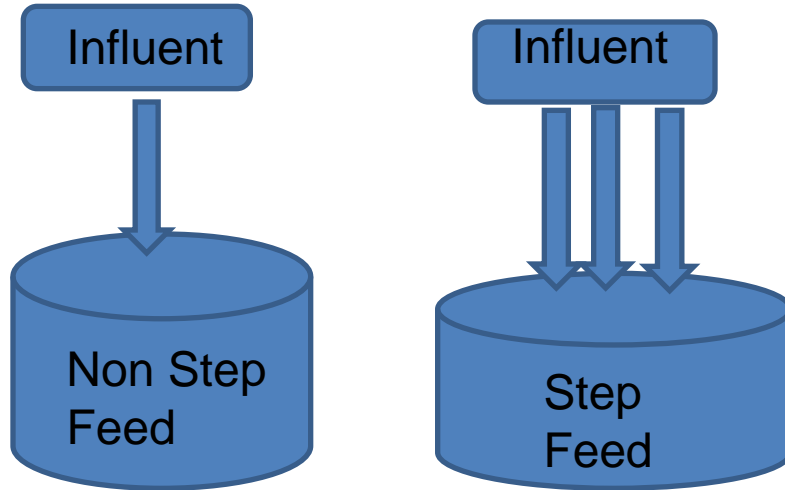
Benefits of Step Feeding

- Controlled solid distribution
- Turbulence
- Ability to distribute loads/ toxins

Research Questions

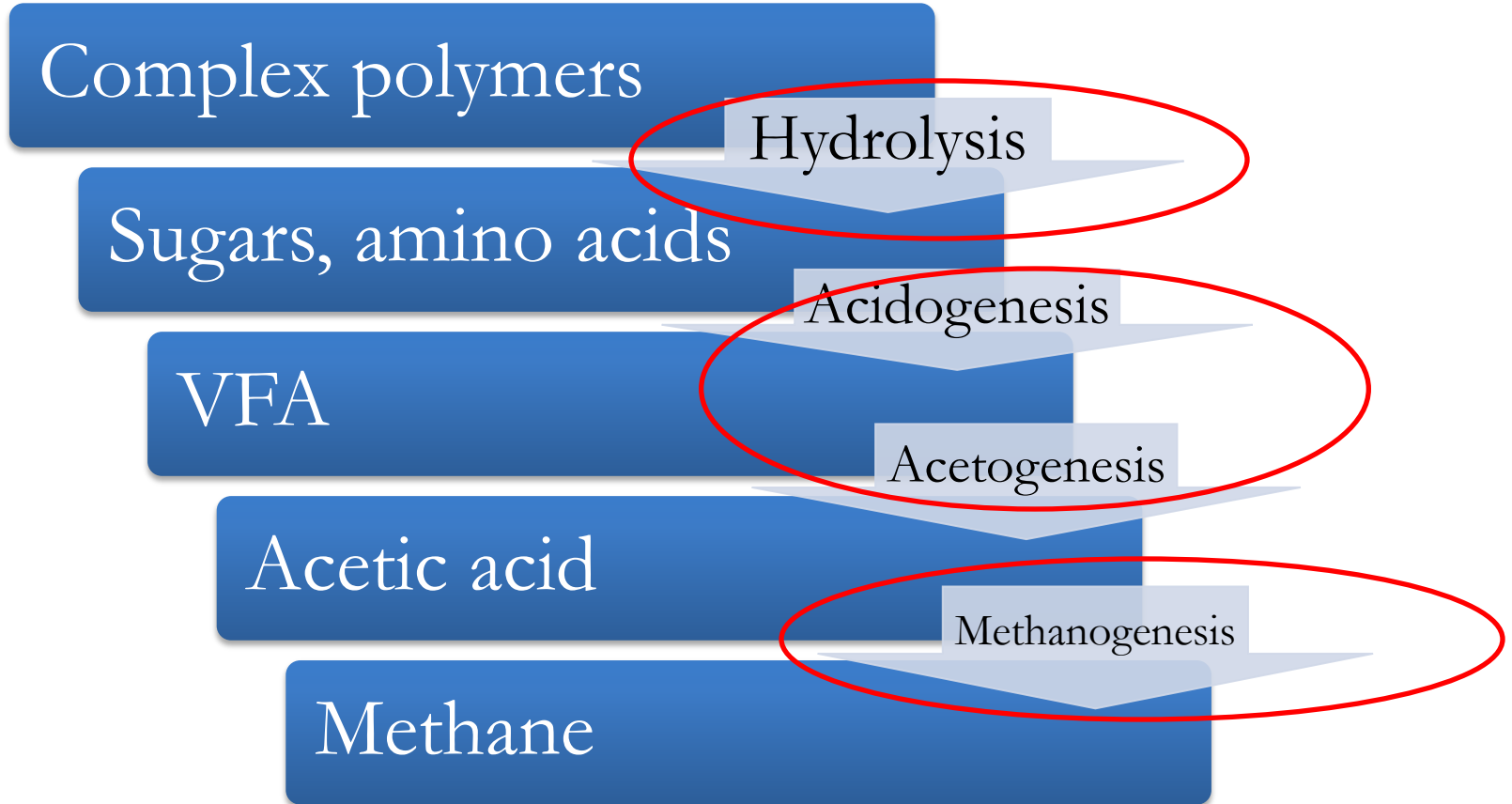
1. Can Step Feeding improve VFA and methane yield?
2. At What HRT(s) can this be achieved?

Bench Scale Evaluation



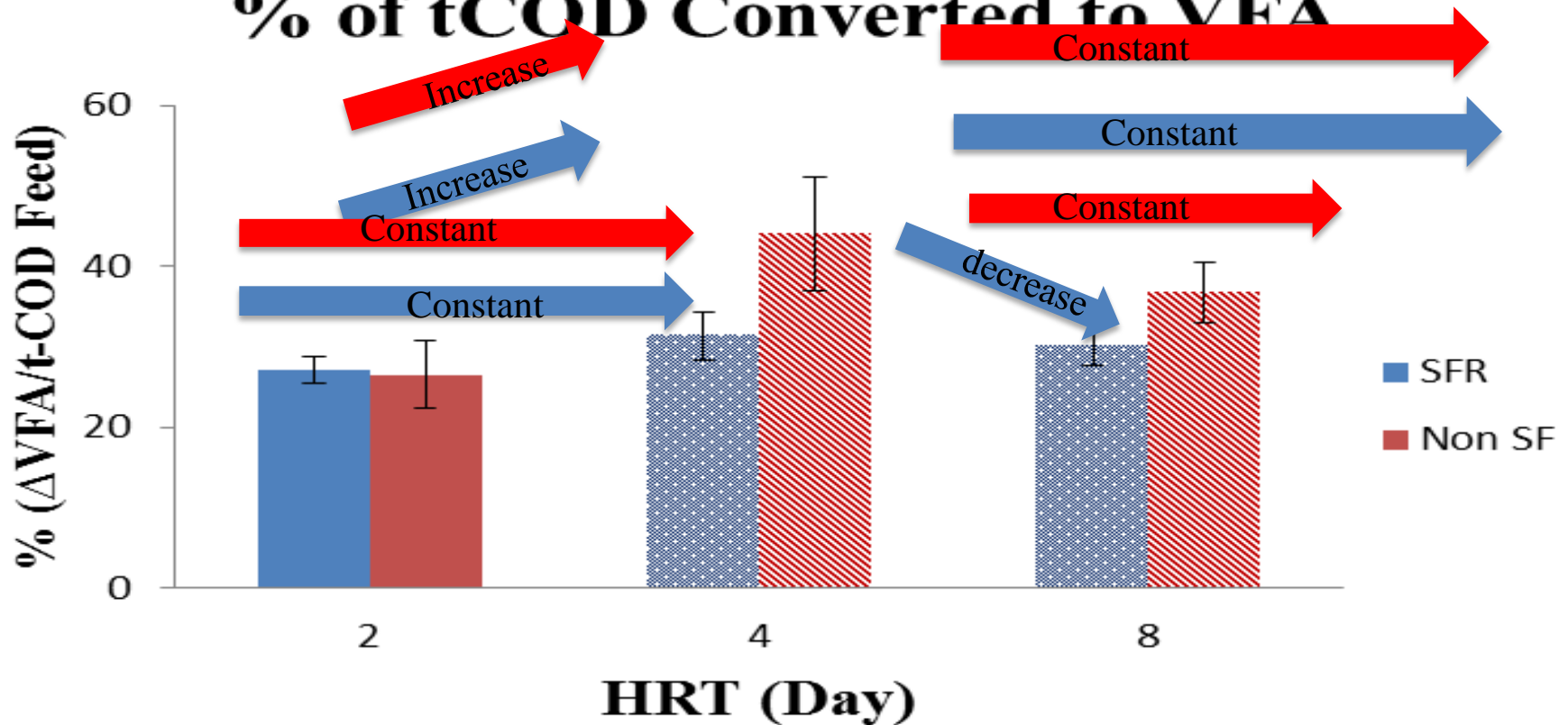
- Monitoring Parameters:
 - Liquid phase
 - COD, NH₃, NO₃⁻, NO₂⁻, VFA, TS
 - Gas Phase
 - Flow rate, CH₄, CO₂

Fermentation Pathway

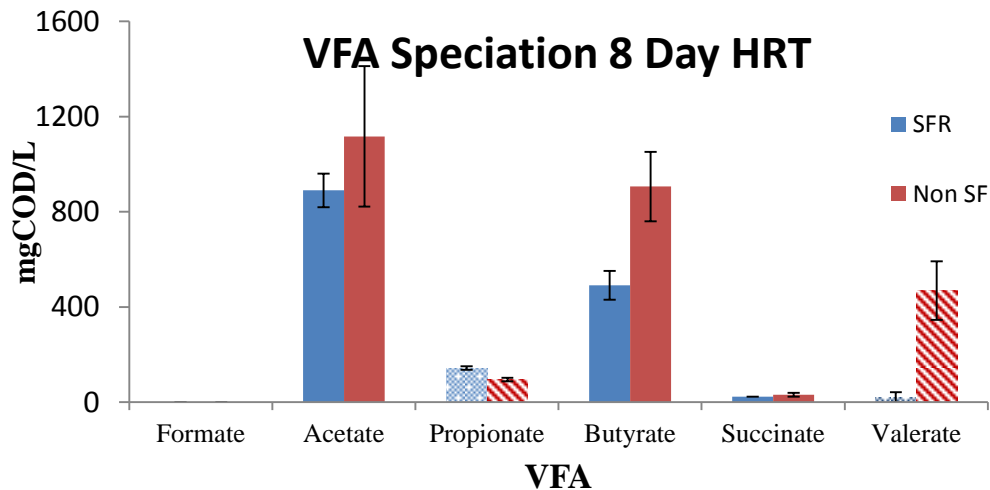
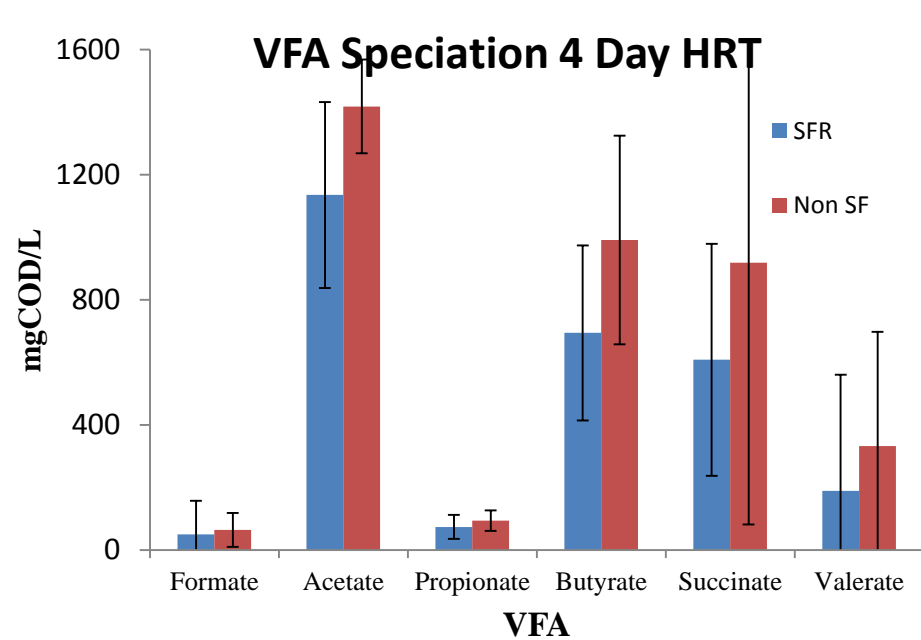
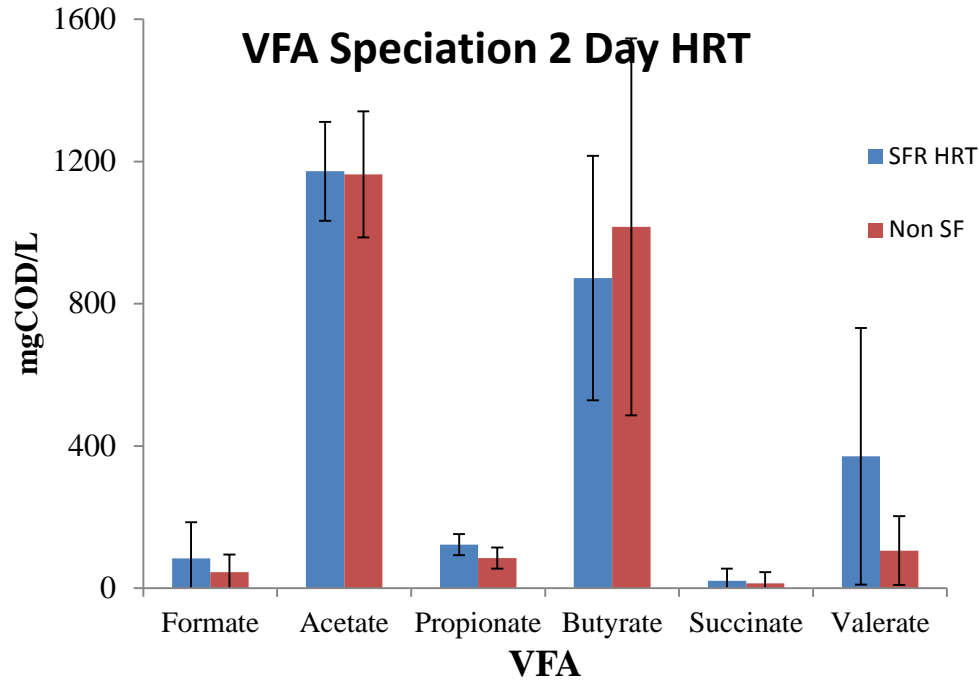


% of tCOD Converted to sCOD

% of tCOD Converted to VFA

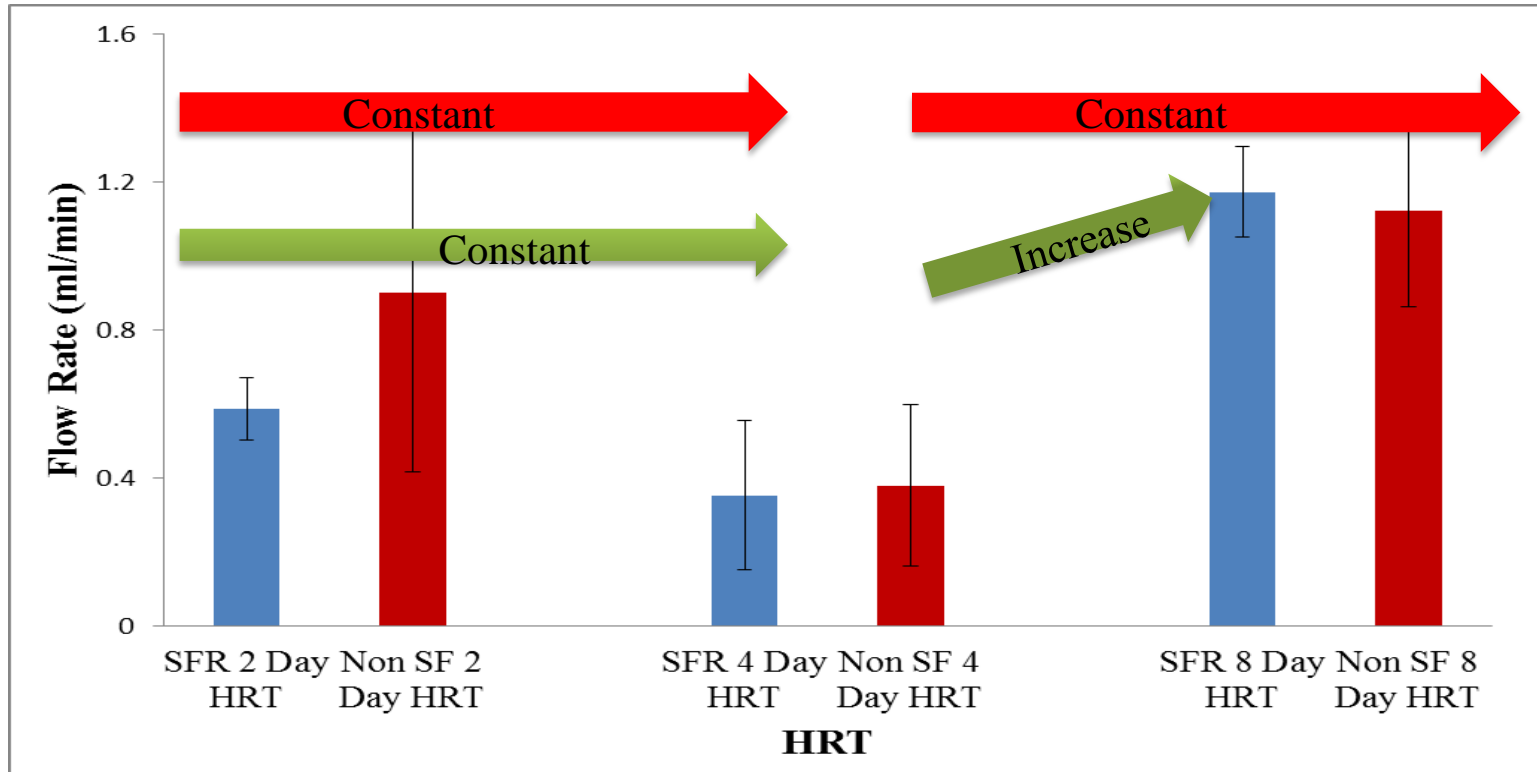


- Hydrolysis (particulate to soluble) increases with increasing HRT and then levels off
- Only at the highest HRT is hydrolysis in SFR lower
- Acid production is statistically similar for all HRTs for non SF
- Acid production for SFR is similar for 2d and 4 d HRT
- Acid production in SFR decreases at 8d HRT



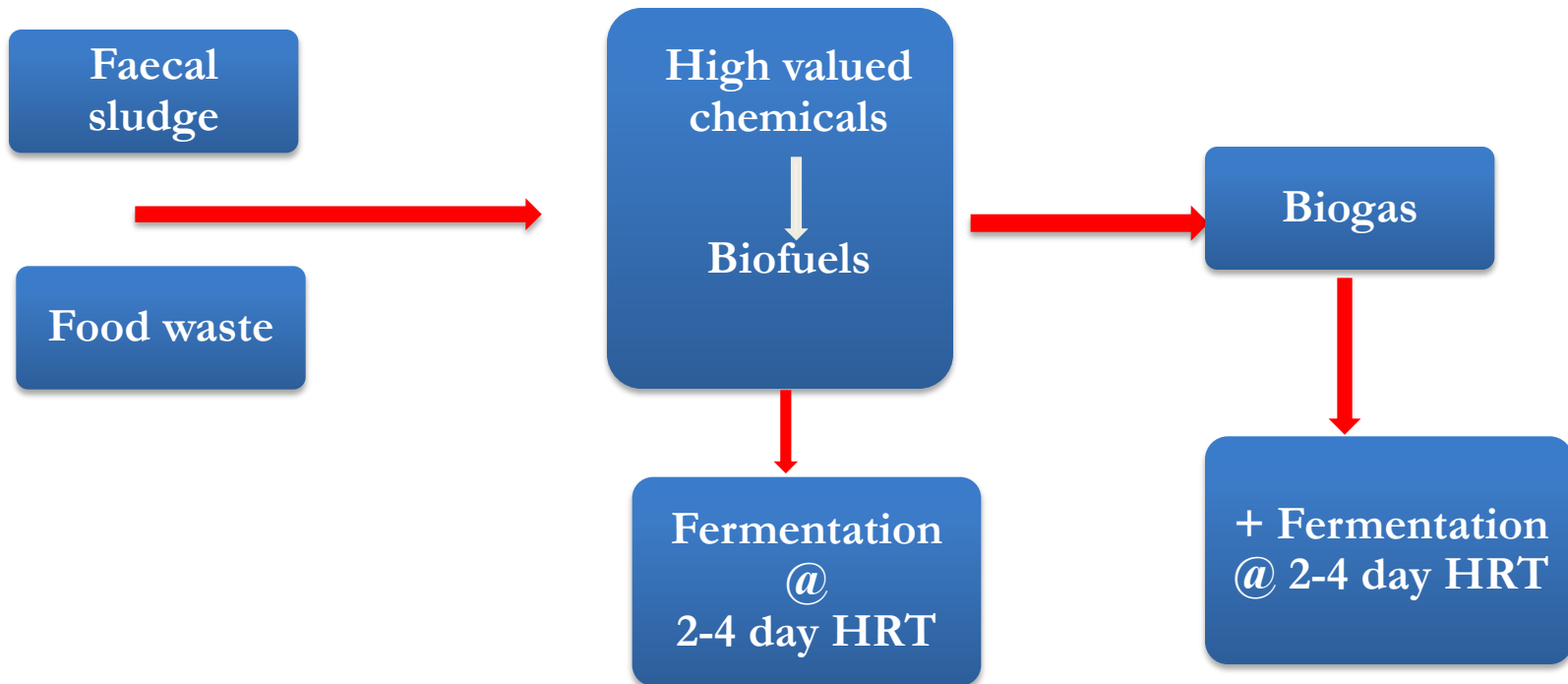
- Acetate and butyrate dominant acids across all HRTs
- Succinate dominant at 4d HRT for both configurations
- Valerate decreases with SFR but increases with Non SF
- Depending on the desired VFA an HRT or reactor configuration can be chosen

Methane flow rate



- Similar Across HRTs for Non SF
- Increase Flow rate for SFR at Higher HRTs

Conclusions



- Step Feed and Non Step Feed are similar from a process point of view
- Looking at mixing, the ability to distribute loads across reactors and ultimately cost, Step Feeding is a good alternative to the non step feed approach

Thank You.



Acknowledgements

- Bill and Melinda Gates foundation
- Kumasi Metropolitan Assembly

Contact information:

Prof. Kartik Chandran e-mail: kc2288@columbia.edu

Ato Fanyin- Martin e-mail: fanmart2001@gmail.com

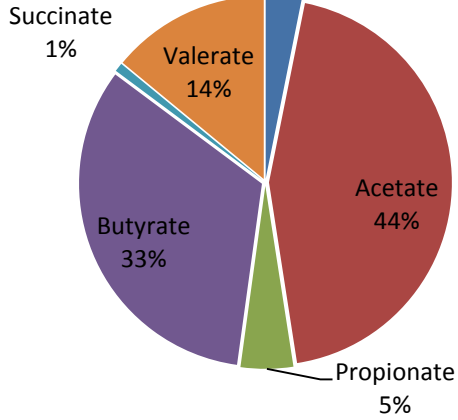
Uses of VFAs

- Acetate, precursors to other chemicals, global demand exceeds 6.5 million tonnes per year
- Butyrate – probiotics
- Succinates- precursors to polyesters, Food and beverage industry
- Valerate- Food additives

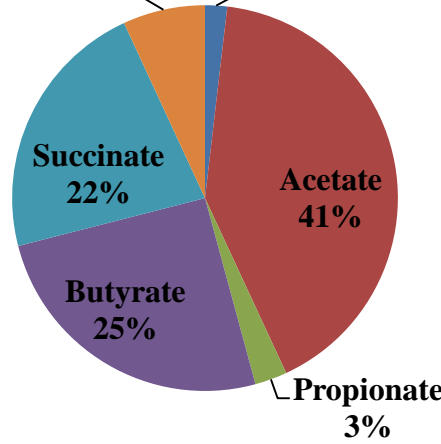
Further work

- Modelling using Biowin
- Biogas composition using GC
- Metagenomics

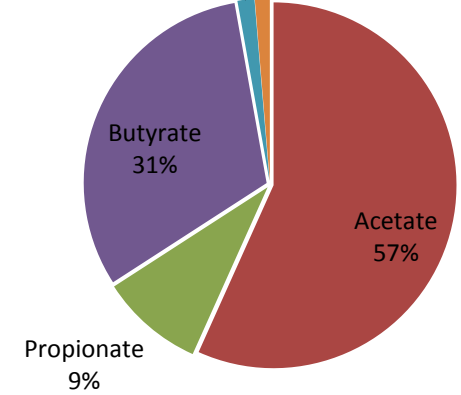
SFR 2Day HRT



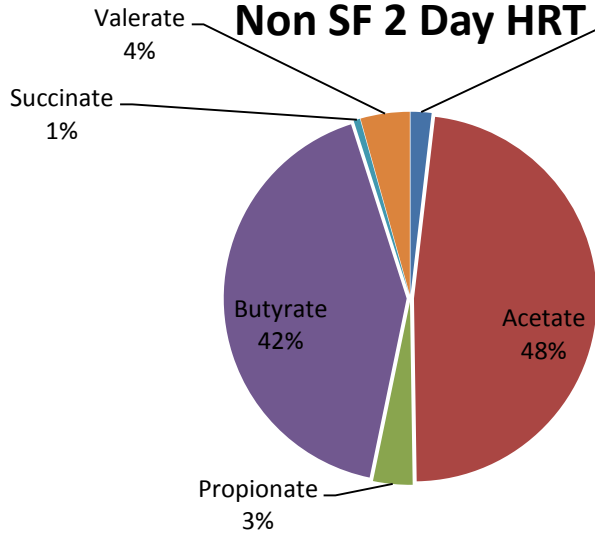
SFR 4Day HRT



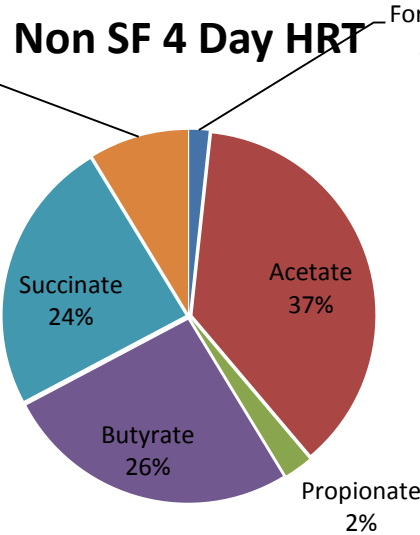
SFR 8Day HRT



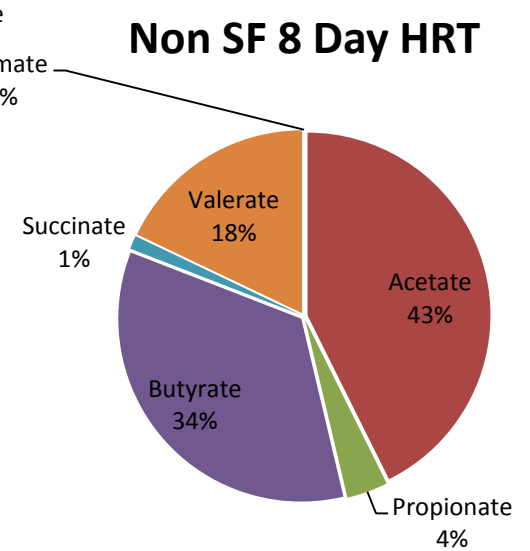
Non SF 2 Day HRT



Non SF 4 Day HRT



Non SF 8 Day HRT



T-test

dVFA/tCOD-feed							
Ttest SBR vs SFR							
t-test 8days							
HRT	0.000		tTest: 8 vs 4		tTest 8 vs 2		tTest 4 vs 2
T-test 4days							
HRT	0.002	SFR	0.3859	SFR	0.0018	SFR	0.0084
Ttest 2 days							
HRT	0.68	SBR	0.0354	SBR	0.0000	SBR	0.0002
dsCOD/tCOD-feed							
Ttest SBR vs SFR							
t-test 8days							
HRT	0.003		tTest: 8 vs 4		tTest 8 vs 2		tTest 4 vs 2
T-test 4days							
HRT	0.18	SFR	0.1453	SFR	0.3075	SFR	0.2410
Ttest 2 days							
HRT	0.55	SBR	0.1137	SBR	0.1076	SBR	0.0422
dVFA/d-SCOD							
Ttest SBR vs SFR							
t-test 8days							
HRT	0.039		tTest: 8 vs 4		tTest 8 vs 2		tTest 4 vs 2
T-test 4days							
HRT	0.860	SFR	0.0067	SFR	0.0102	SFR	0.2483
Ttest 2 days							
HRT	0.91	SBR	0.1774	SBR	0.4392	SBR	0.5094