DISCUSSION
From the data the reactors maintained at different temperatures viz., 20°C, 35°C and 55°C showed variation in digesters performance. Thermophilic anaerobic process normally operates between 50°C and 60°C and because of the higher metabolic activities of thermophiles, the processes are capable of accommodating a very high loading rate at feasible removal efficiency as an alternative for treatment of middle and high strength wastes. Methanogens span a wide range of growth temperatures, from moderate psychrophiles that grow optimally at temperatures around 20°C to hyper-thermophiles that grow at temperatures up to 110°C (Boone, D.R., et al., 1993) and yet the thermophilic processes are less stable and more sensitive to environmental changes than mesophilic processes (Hirayuki Imachi et al., 2000). The possible reason could be attributed to accumulation of inhibitors (e.g. VFAs) which in turn changes the pH of the digesters. The digestion process was found to be optimum at pH range of 6.7 – 7.4 and pH values below 6.0 or above 8.0 was highly restrictive.

A tenfold reduction in COD was observed in digesters incubated at 35°C and 55°C, while digesters at 20°C showed a less than two fold decrease.

The net biogas content was comparatively higher for IL2 (CDS) digesters and lowest for IL3 (LFS), thermophilic digesters recorded higher VFA accumulation in IL3 and while IL2 digesters had 41.7% higher VFA at thermophilic condition.

Higher load of methanogens was noticed in thermophilic digesters, higher concentrations of VFA have been expected to temporarily block methanogenesis, but the metabolic activity resumed immediately with neutralization of the inhibitors. The Eubacterial and archaeal load varied widely among the digesters and no single inoculum could be judged as better than the other as their performance varied with change in temperature and this was the possible reason for developing a consortium from natural inoculum sourced from different environment.

By participating in the terminal steps of organic material degradation, methanogenic archaea play a pivotal role in the anaerobic treatment of solid waste (Robin C Anderson et al., 2003). Total methanogen load peaked during 5th week of thermophilic digestion which was accompanied with drastic decrease in the load of total anaerobic eubacteria, and an exactly opposite effect was observed in 5th week of digester incubated at 20°C. The peaking of
methanogenic population in the 5th week of thermophilic digesters was accompanied with drastic reduction in COD of the digester sample, followed by reduced VFA accumulation and slight increase in pH. Conversely a peak of total anaerobic eubacteria lead to drastic increase in VFA leading to decrease in load of total methanogens which was evidently observed in least biogas production and low methane yield.

Hydrogen producers can increase methane production, while the inhibition of hydrogen producers leads to accumulation of propionate, at the expense of acetate, propionate may be useful inside ruminants, because propionate on oxidation releases more free energy for animals productive purpose, but in anaerobic digesters they are not productive. In competitive interactions among different species of bacteria, the capability for growth on the lowest concentration of a growth limiting substrate may be the major factor determining the population outcome.

Another possible way to improve thermophilic anaerobic digestion of urban waste involves mixing equal ratio with cow dung as a substrate. Compared with structural carbohydrates (for example: cellulose), it was observed that the fermentation of non-structured carbohydrates (starch, sugars) results in less methane per unit of substrate fermented (Andrea Macmuller et al., 2003). The gradual reduction in the gas production during the later period of incubation was due to the accumulation of volatile fatty acid, which inhibits methanogenic activity. Substrates with higher C/N ratio may reduce biogas production further, aspects that affect biogas production is high level of readily degradable compounds (e.g. more starch) or high level of recalcitrant compounds (lignocelluloses). Anaerobic digestion of low C/N ratio based substrates had to be operated at longer HRT (Panichmunsin et al., 2006).

Branched chain fatty acids have stimulatory effect on cellulose digestion. Addition of starch can produce enough branched chain fatty acids for the requirement of cellulolytic rumen bacteria, and high concentration of starch as inhibitory effect on the growth of cellulolytic bacteria (Nideki miura et al., 1980). Thus the problem of VFA as an inhibitor of methanogenesis can be overcome by supplementing the urban waste based digester with cow dung. The Supplementary of Branched chain fatty acids are effective only when the main components of cellulose and urea are more. The methane content of the biogas increases with increase in HRT. High pH can be achieved in the digesters with substrates rich in readily available carbohydrate and low in protein.
Angelidaki and Sanders, (2004) highlighted that hydrolysis depends on the concentration of the substrate; therefore, the highest production of VFA is to be anticipated in the first day after incubation. Methods to calm the initial acidic bursts during reactor initiation may be necessary to ensure that the digester can proceed to the steady-state stage. An average of 65% CH\textsubscript{4} was obtained after 10 days of start-up period. The reactors were buffered for 9 straight days. This nine day buffering period includes the first 4 days for these reactors to reach 50% methane and another 5 days were allocated to check whether these reactors would sustain this minimum 50% methane production. The reason was to ensure that a strong population of methane generators have developed (based on >50% CH\textsubscript{4}) that would be able to convert the produced VFAs. Therefore, buffering can be stopped with surety that the anaerobic system within these reactors is capable of self-regulation. The quick high methane production (where 65% methane is being produced in less than 11 days) could have also been a combination from adding trace elements as well.

Operating condition and temperature for laboratory digesters has to be standardized to generate biogas from the urban waste. From the above data it is clearly evident that urban waste can be used as a potential source for biogas production. The use of urban waste can reduce the problem of pollution. Methane yield and microbial activity can be correlated for better gas production. Pure methane at standard temperature and pressure has a lower heating value of approximately 34,300 kJ m\textsuperscript{3}. Biogas, however, is typically only 40-80% methane and therefore, has a heating value of approximately 13,720 – 27,440 kJ m\textsuperscript{3}. Methane can be used for all the purposes where natural gas of fuel in a gasified form is used for cooking, lighting, refrigerator, incubator, gasoline engine, etc.