FAME PRODUCTION FROM WASTE COOKING OIL THROUGH TRANSESTERIFICATION-OZONATION REACTION
– Generation of Gas-Liquid Flow in a Microchannel –

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BACKGROUND

- The scarcity of petroleum reserves will give the opportunity for renewable energy sources development
- A high percentage of FFA in WCO is a good opportunity for using it as raw material to produce biodiesel.
- The biodiesel stability is low due to high concentration of unsaturated ester. It can be improved by cracking double bond carbon chain (C=C)
- Transesterification-ozonolysis reaction involving three phases gas-liquid-liquid will take place in microchannel. Therefore, a study of characteristic flow pattern in microchannels is needed.

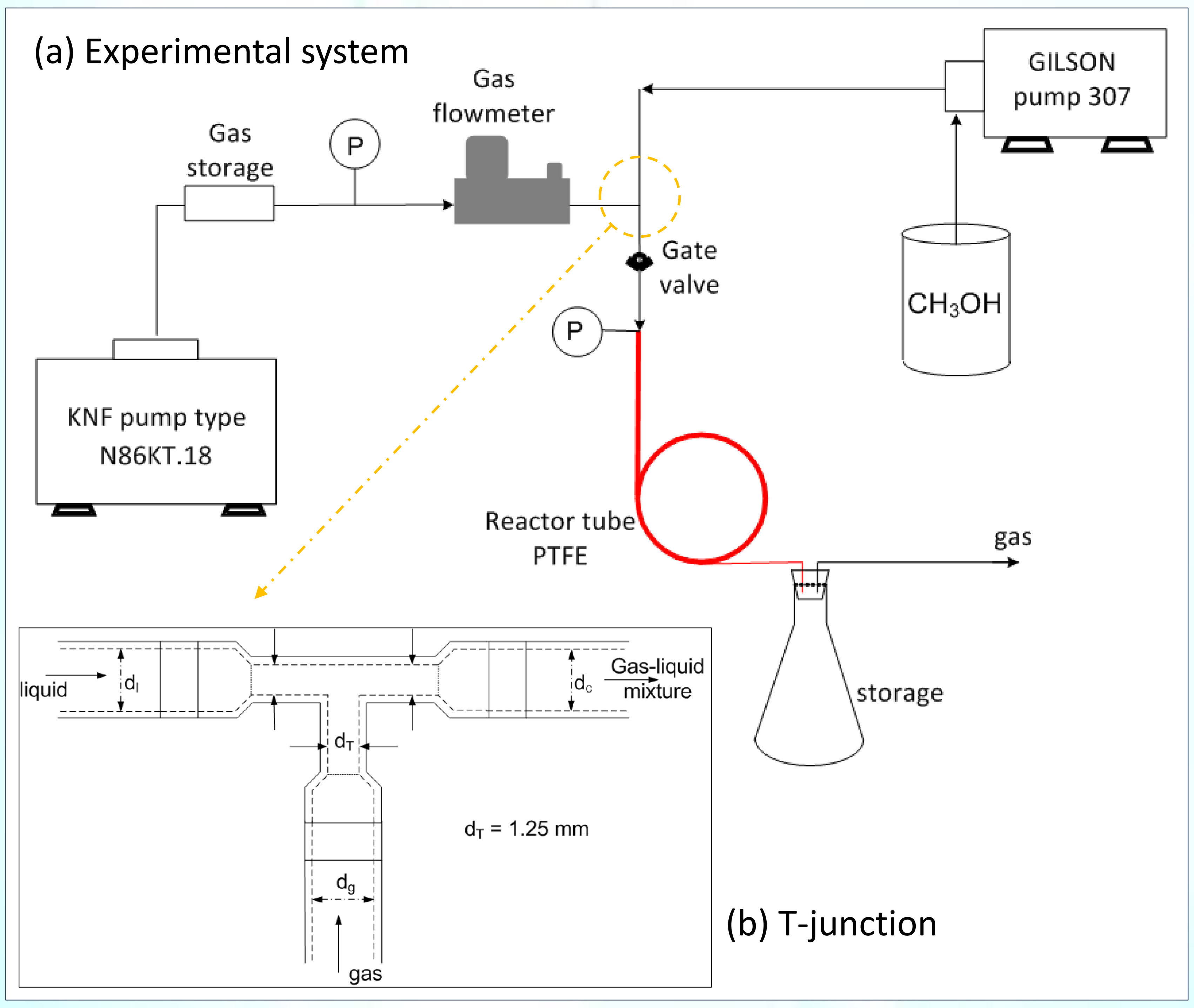
OBJECTIVES

The study aims to find an intensified process technology for producing high-quality biodiesel involving double bond cracking in WCO to methyl esters, low energy consumption, process safety, high selectivity, and conversion. Therefore the purpose of this research is:

- To find the characteristic flow pattern of gas-liquid in the microchannel by using air-methanol as a reference to carry out the transesterification-ozonolysis reaction in the microchannel.

MATERIALS & METHOD

Scheme of experimental equipment :



Range of air-methanol flow rate & dimensionless number:

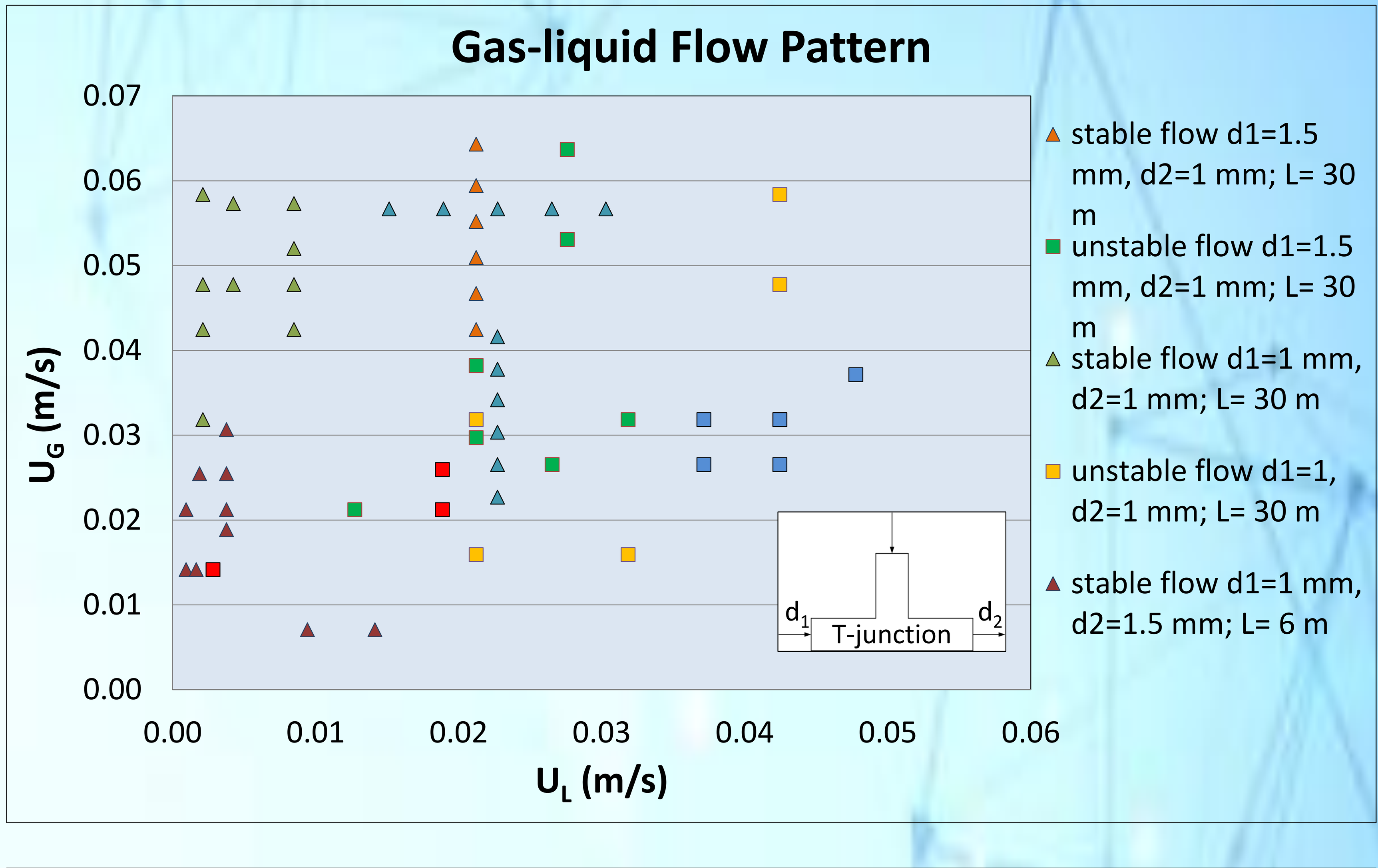
- Methanol flow rate (Q_L) = 0.06–2.8 ml/min
- Air flow rate (Q_g) = 0.25–3.25 ml/min
- Reynolds number phase liquid (Re_L) < 80
- Reynolds number phase gas (Re_G) < 7.5
- Capillary number (Ca) = 0.000025 – 0.0018

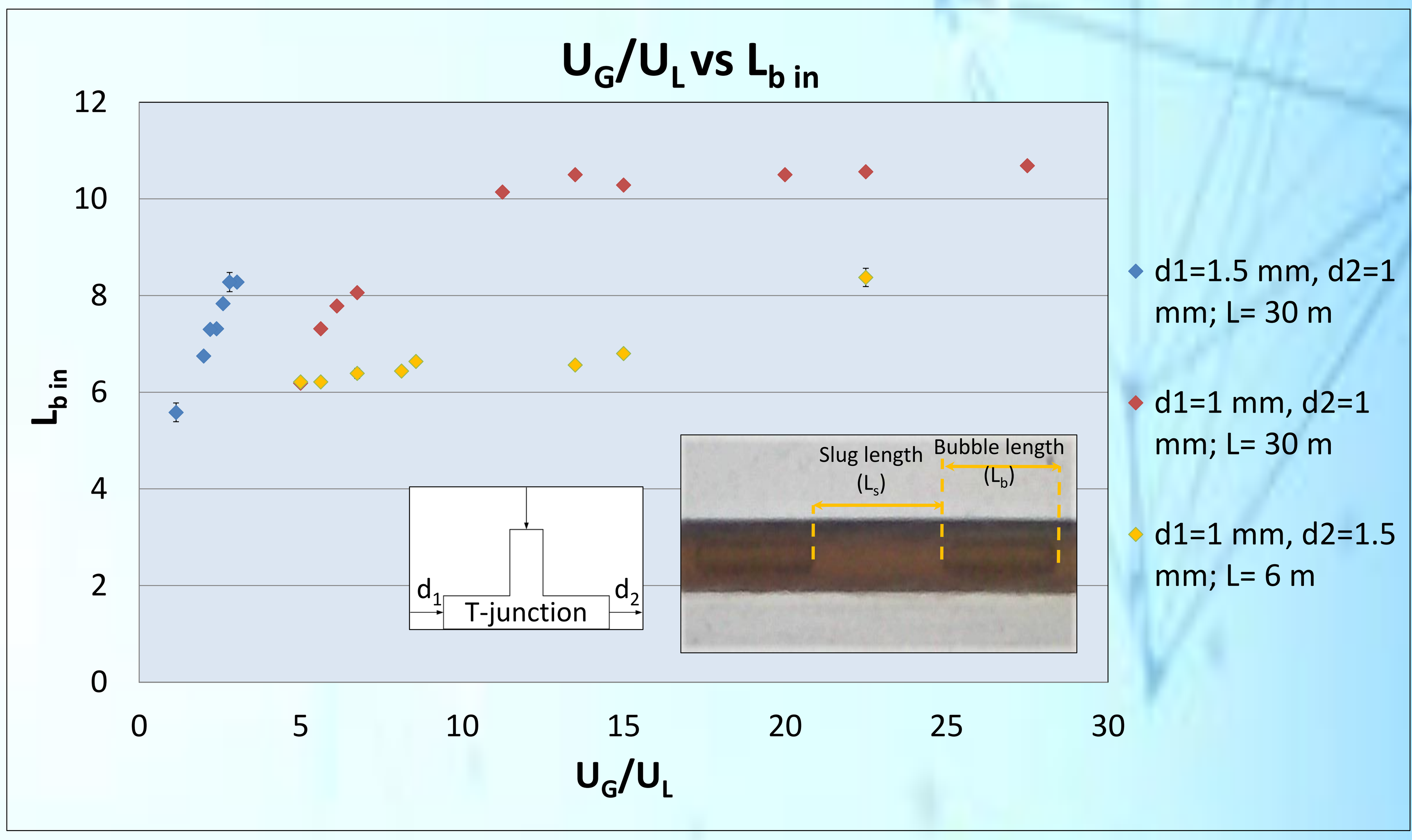
$$Re_L = \frac{\rho_L . U_L . d_h}{\mu_L} \qquad Re_G = \frac{\rho_G . U_G . d_h}{\mu_G} \qquad Ca = \frac{\mu_L . U_L}{\sigma}$$

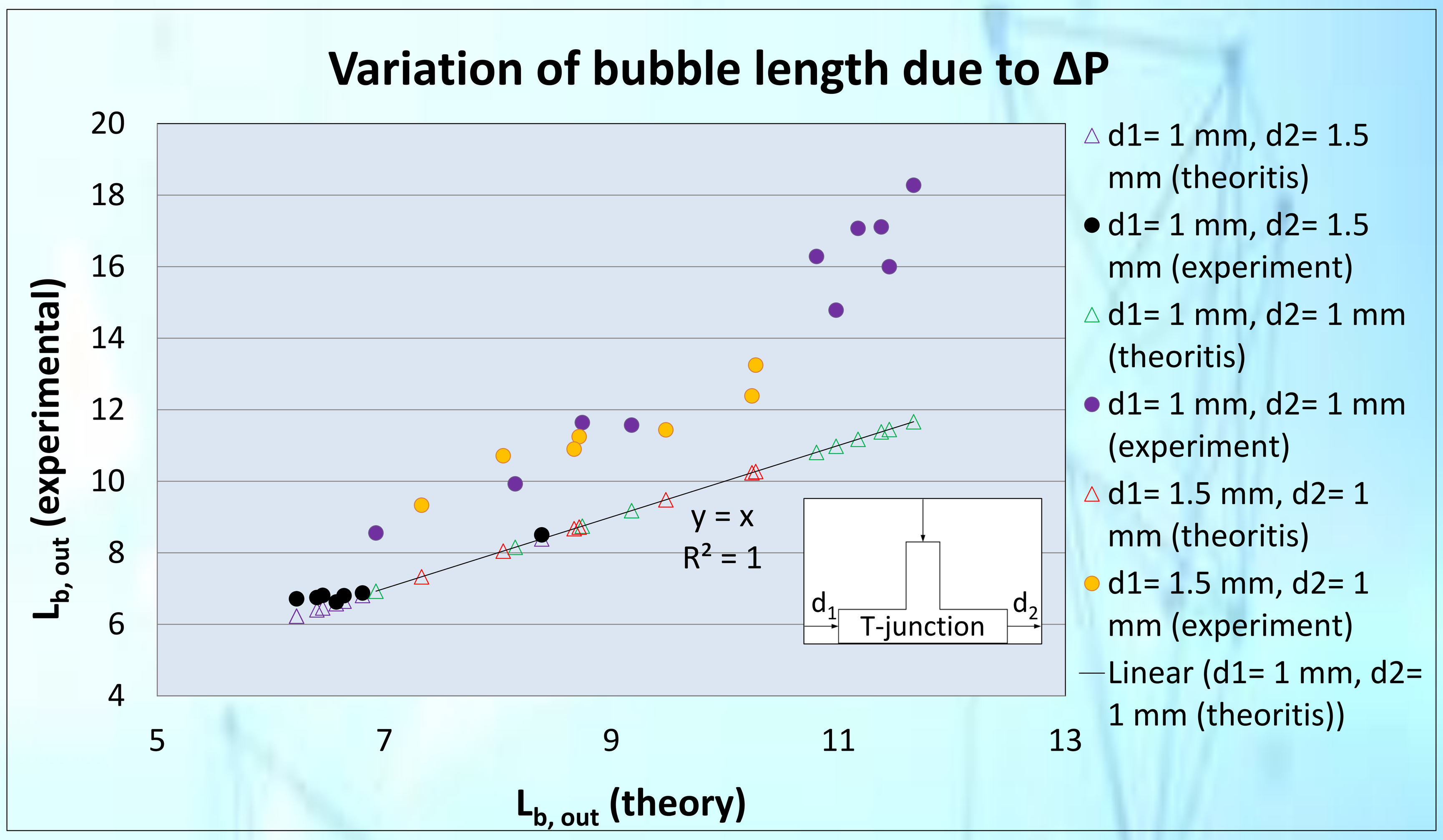
- d_c = 300; 530; 1000; 1500 µm; d_g = 500 µm
- $P_{gas\ inlet}$ = 1.2 bars

ρ = density
μ = viscosity
U = superficial velocity
d = diameter
σ = surface tension
L = liquid
G = gas
c = channel

RESULTS







CONCLUSIONS

1. The observed flow patterns in the microchannel with ID = 1 mm, 1.5 mm are Taylor and annular flow.
2. The length of bubble increases with the increase in the ratio of superficial-gas velocity to superficial-liquid velocity.
3. The length of bubbles in inlet and outlet section of the tube is different
4. The change of the length of the bubbles are due to the pressure drop along the tube and sometimes to coalescence phenomena

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