GASIFICATION AS A METHOD OF THE SWAGE SLUDGE MANAGEMENT – EVALUATION OF THE POSSIBILITY OF THE PRODUCED GAS USAGE AS A FUEL

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INTRODUCTION

Nowadays, an intense development of technologies using renewable energy sources is observed. One of these technologies is biomass gasification. As a result of this process combustible gas is produced. Laminar flame speed is one of the important parameters describing the combustion process of such gas.

The aim of the study was to determine the laminar flame speed of the gas from sewage sludge gasification as a function of excess air ratio.

Laminar flame speed plays an important role in issues connected with flame stability. The flame is stable when there is a local equality: normal component of the flow velocity of the mixture is equal to the laminar burning velocity. If the mixture flow speed is greater than the speed of the laminar flame speed, the flame is blown off. On the other hand, if the mixture speed is smaller than the laminar flame speed, the flame is drawn into the burner. As the gases from biomass gasification are not typical gases used for burning, there is a need to determinate their laminar flame speed.

EXPERIMENT

1. *Sewage sludge gasification equipment facility – gasification gas production*

Table 1. Properties of the sludge gasified

Parameter	Sewage sludge
Ultimate analysis, % (dry basis)	
C (dry)	27.72
H (dry)	3.81
O (dry)	3.59
N (dry)	13.53
S (dry)	1.81
F (dry)	0.003
Cl (dry)	0.033
Proximate analysis, % (as received)	
Moisture	5.30
Ash	44.20
Volatile matter	49.00
LHV, MJ/kg	10.75

Fig. 1. Fixed bed installation

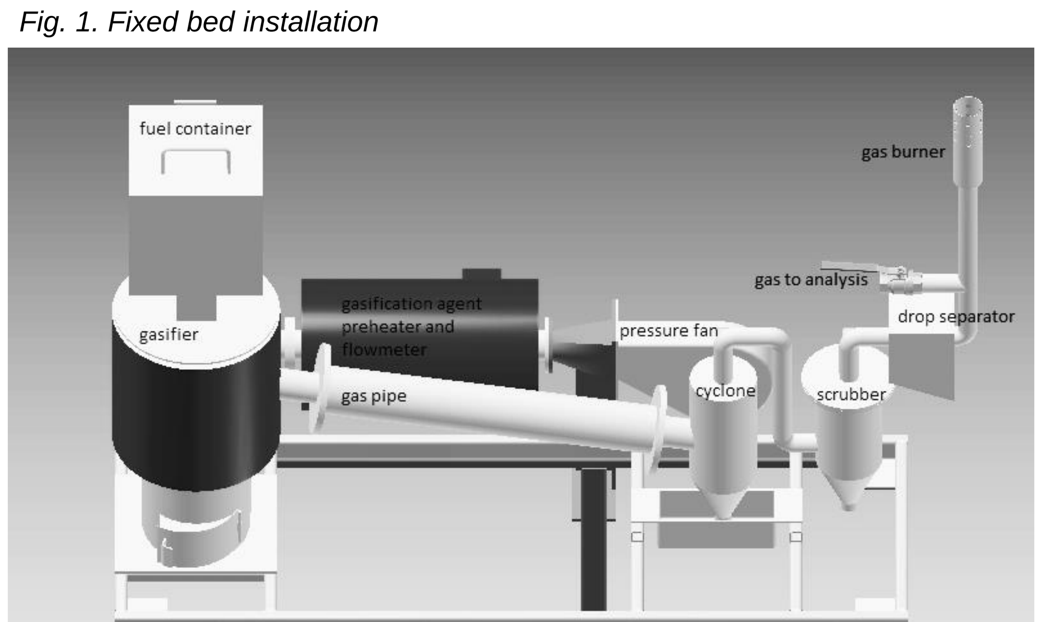


Table 2. Characteristic of sewage sludge gasification gas

CH_4, %	CO, %	N_2, %	H_2, %	CO_2, %
1.0 %	28.5%	50.5%	5.0%	15.0%

2. *Laminar flame speed measurements facility*

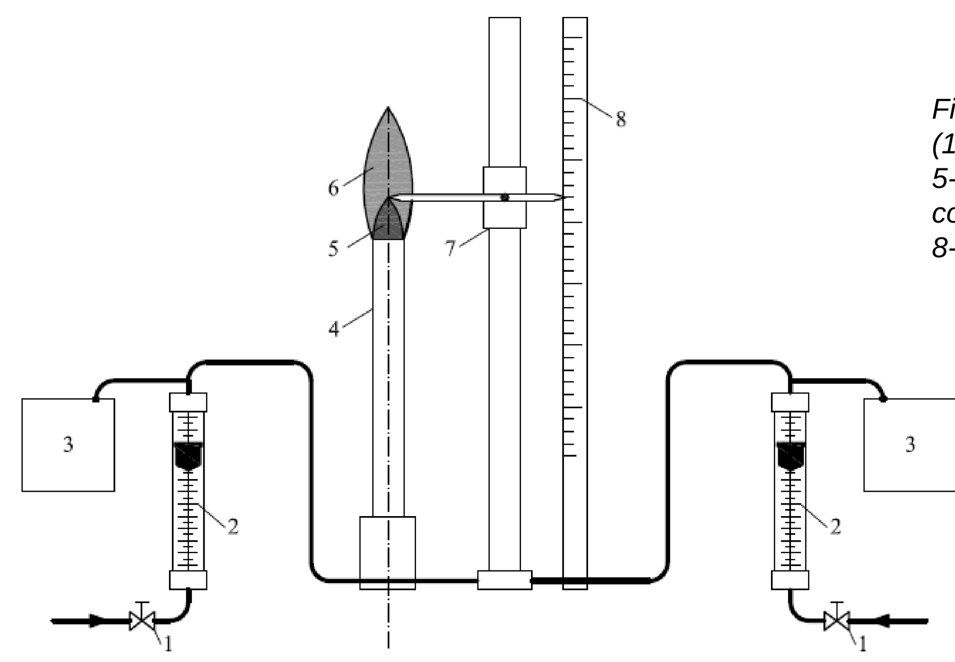


Fig. 2. Laboratory stand used during experiment (1-valves, 2-rotameters, 3-manometers, 4-burner, 5-inner combustion (kinetic) cone, 6 - outer (diffusive) combustion cone, 7-stand with a moveable pointer, 8-ruler)

RESULTS

Fig. 3. Laminar flame speed of gas from sewage sludge gasification as a function of excess air ratio λ.

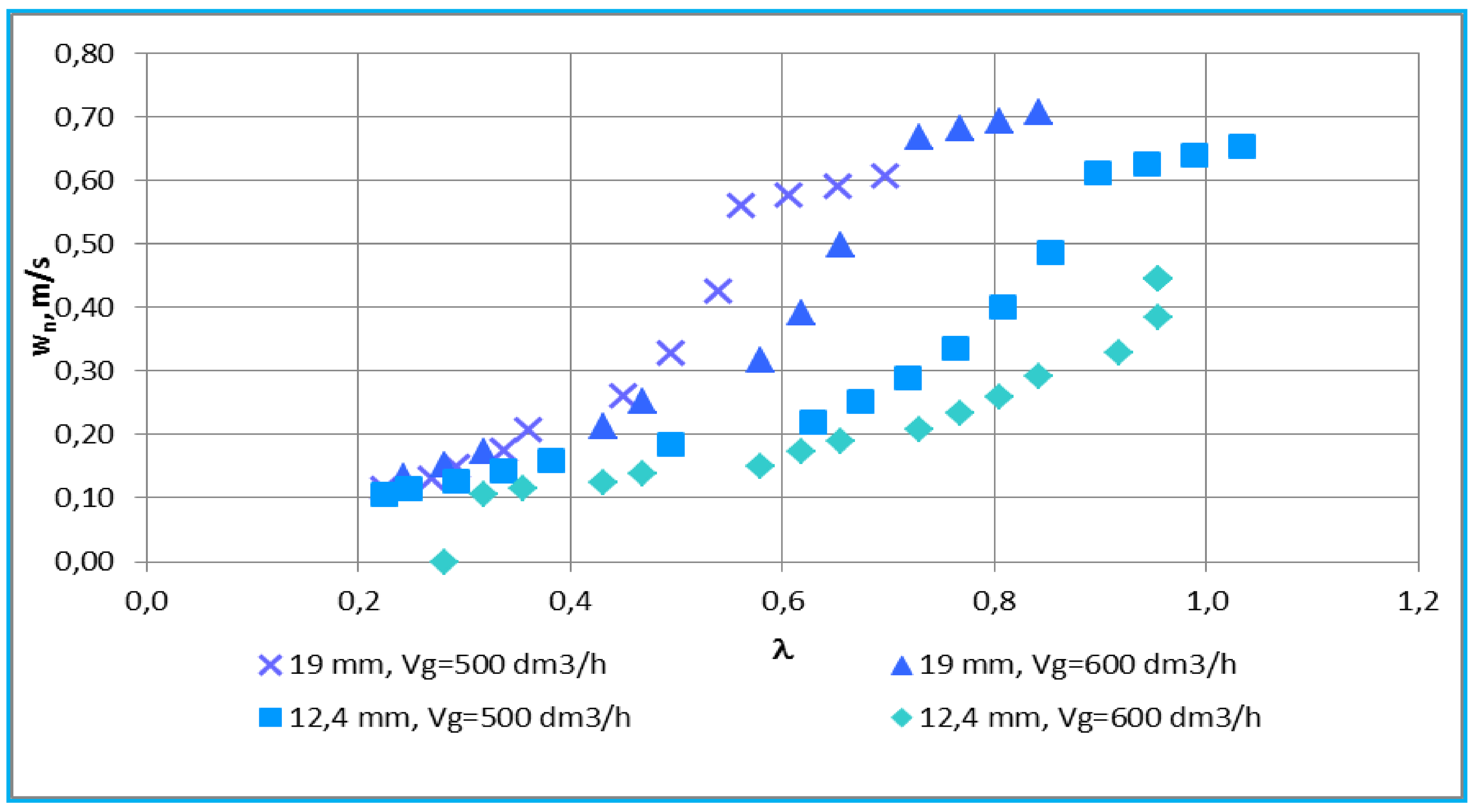
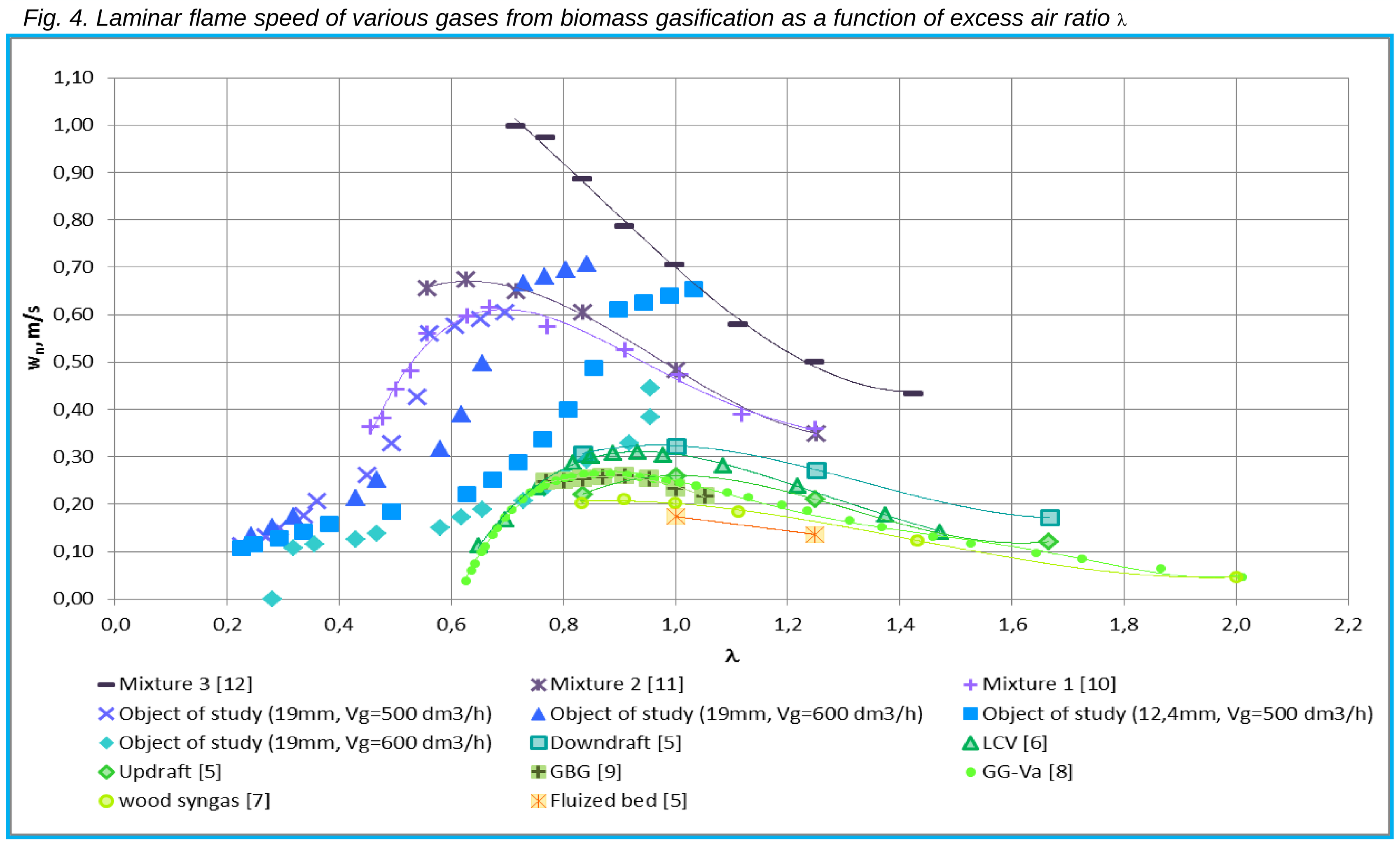


Fig. 4. Laminar flame speed of various gases from biomass gasification as a function of excess air ratio λ



CONCLUSIONS

Laminar flame speed is does not depend on the diameter of the burner. Graph of the laminar burning velocity as a function of excess air ratio, has a shape similar to the shape of a bell curve, which has a maximum at λ ≤ 1. The results obtained from measurements are only a fragment of the bell curve. Determination of the laminar flame speed for greater excess air ratio was not possible because the flame was blown off. The value of laminar flame speed of the gas from the sewage sludge gasification obtained from the measurement is greater than the value of laminar flame speed of gases with similar composition. This difference is caused by the specificity and accuracy of the method used for its designation.