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Experimental study of the effect of low pressure and oxygen-enriched environment on cartons combustion characteristics

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Research Background

After entering high altitude areas, symptoms of altitude sickness and hypoxia are prone to occur. Through indoor oxygen enrichment, blood oxygen saturation can be raised and hypoxia can be effectively addressed. Artificial oxygenation facilities are installed in many hotels, hospitals, train carriages and airport terminals. Prior studies have shown that the burning rate rises significantly when the oxygen concentration exceeds 25%, and that the oxygen-enriched environment will apparently increase the probability of indoor fires.



Fig. 1 High plateau airports and artificial oxygenation devices

Experimental Platform

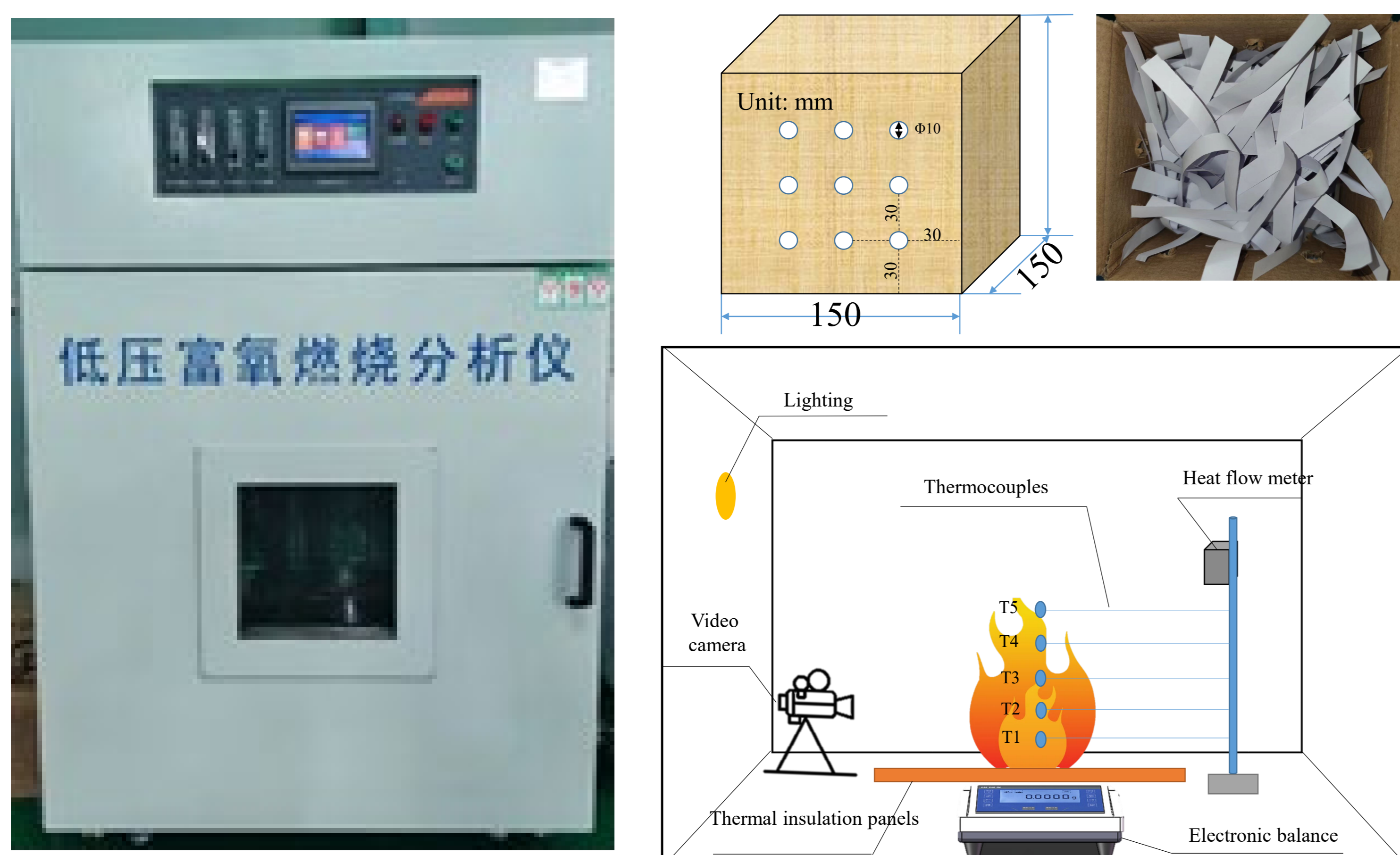


Fig. 2 Schematic diagram of the experimental setup and experimental materials

Results

- The flame becomes brighter and the flame height decreases significantly.
- At high oxygen concentration, pressure is weakly correlated with mass loss and heat production.
- The highest flame temperature occurs in the continuous zone of the fire plume.

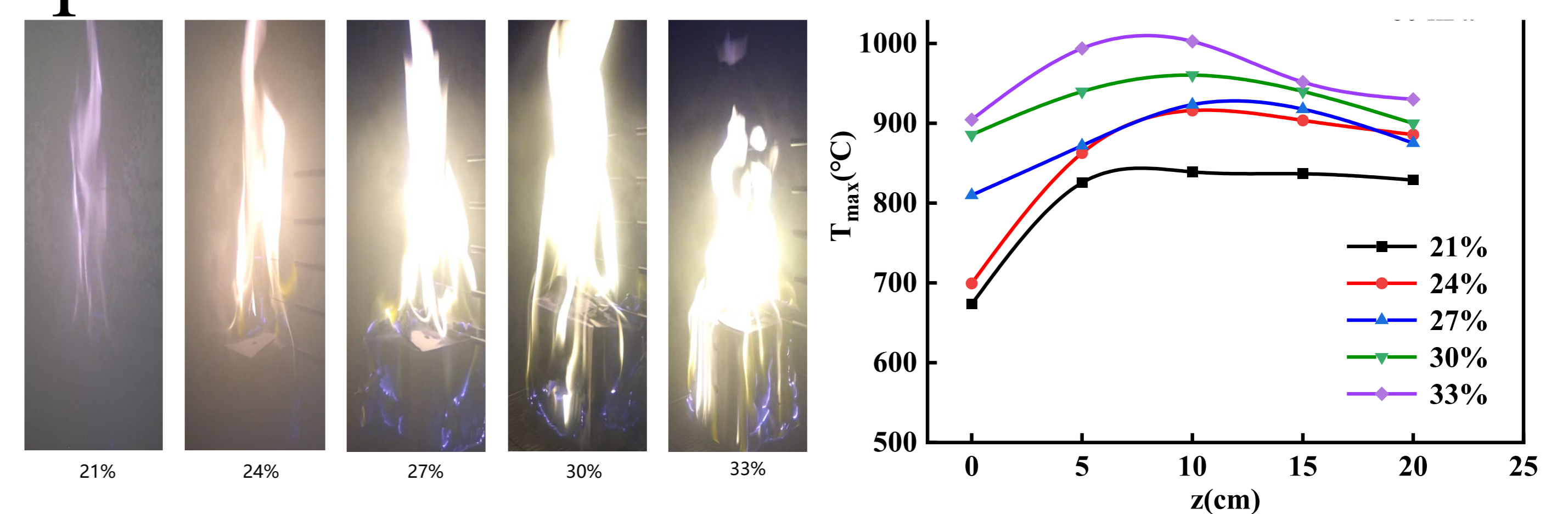


Fig. 3 Flame pattern and flame temperature in 60 kPa

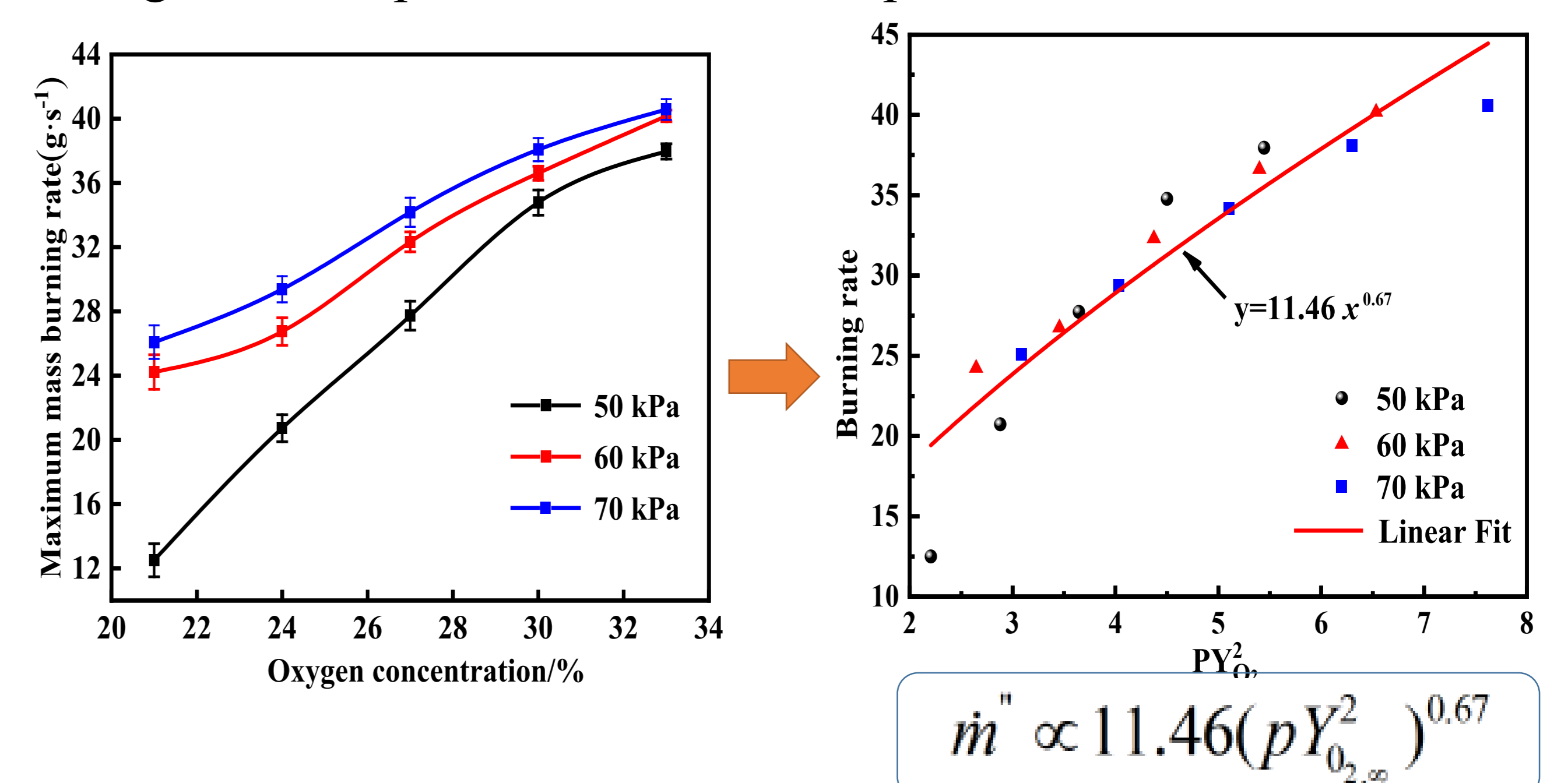


Fig. 4 MLR as a function of pressure and oxygen concentration

References

- [1] WEST J B. Fire hazard in oxygen-enriched atmospheres at low barometric pressures [J]. Aviation Space & Environmental Medicine, 1997, 68(2): 159.
- [2] FENG R, TIAN R, ZHANG H, et al. Experimental study on the burning behavior and combustion toxicity of corrugated cartons under varying sub-atmospheric pressure [J]. Journal of hazardous materials, 2019, 379: 120785.
- [3] WANG W, WANG L, YANG R, et al. Investigation of the effect of low pressure on fire hazard in cargo compartment [J]. Applied Thermal Engineering, 2019, 158: 113775.
- [4] THOMSEN M, FERNANDEZ-PELLO C, Olson S L, et al. Downward burning of PMMA cylinders: The effect of pressure and oxygen [J]. Proceedings of the Combustion Institute, 2021, 38(3): 4837-4844.