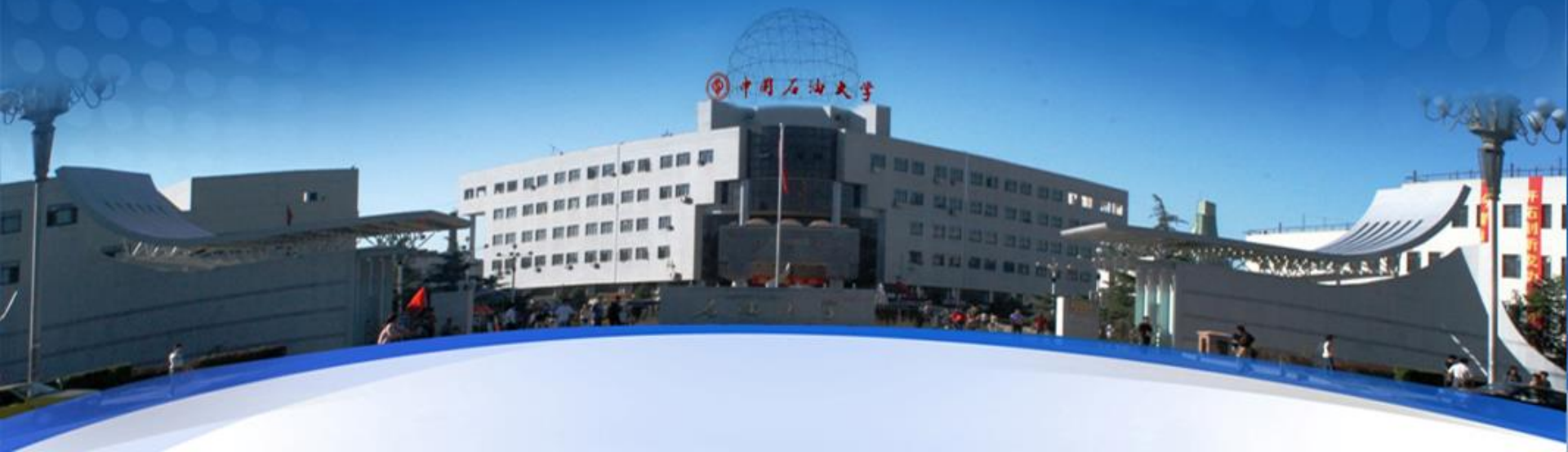
中国石油大学
CHINA UNIVERSITY OF PETROLEUM BEIJING

Experimental Study of Gas-Solid Separation in Gas-Solid Concurrent Axial Moving Bed

Han Lü



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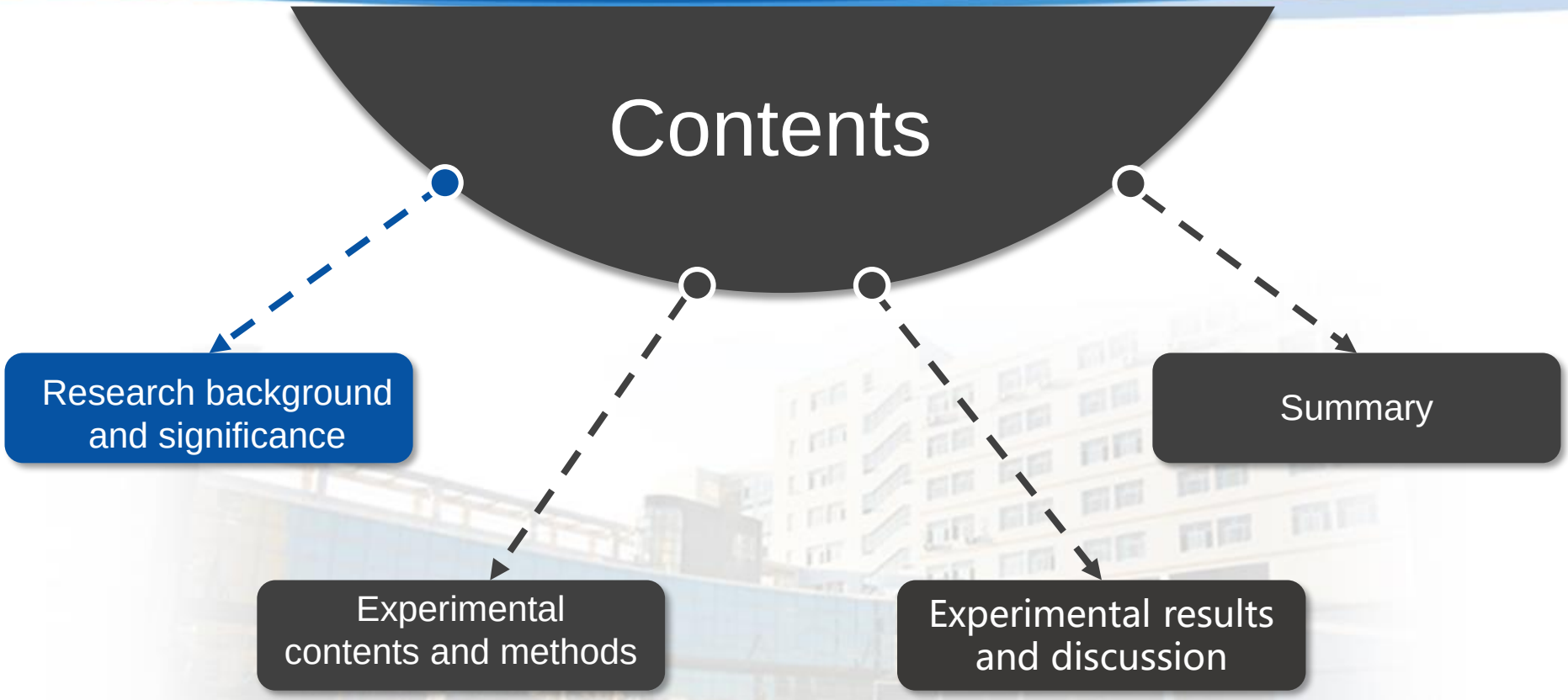
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Firing coal of power station

Haze weather in Beijing

1.Have a bad effect on people’ s lives; 2.Do Harm to human health.

In this research, We hope to reduce air pollution by moving bed filter technology.

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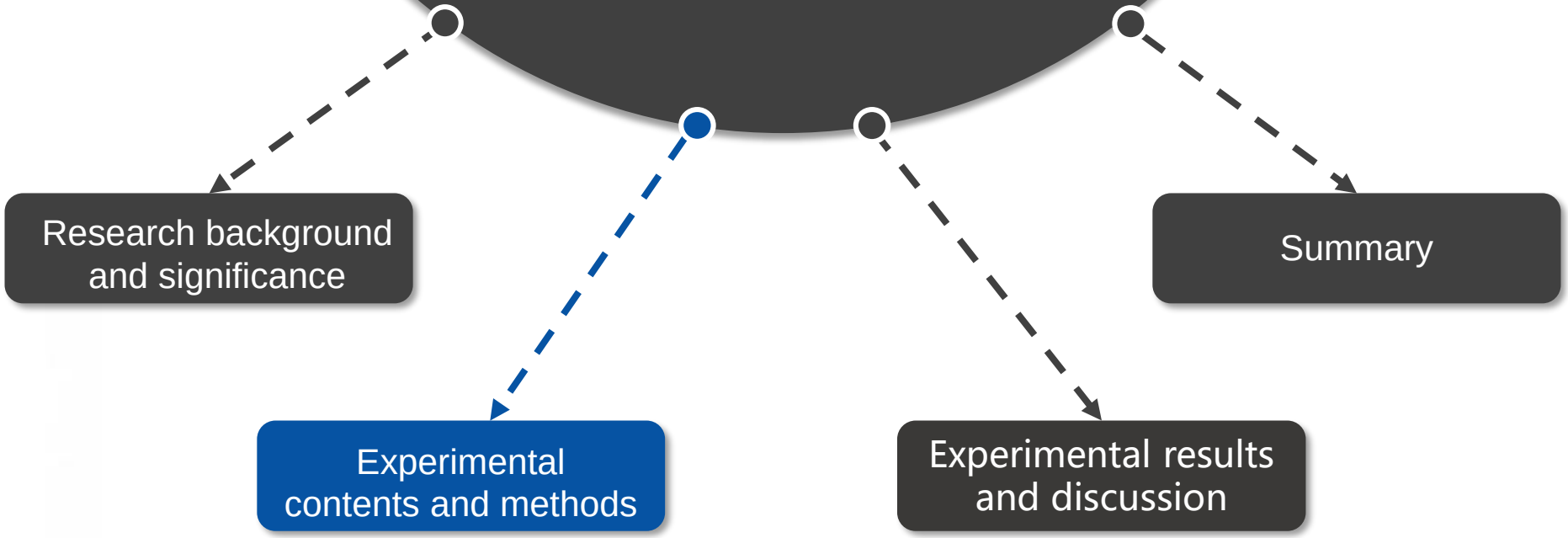
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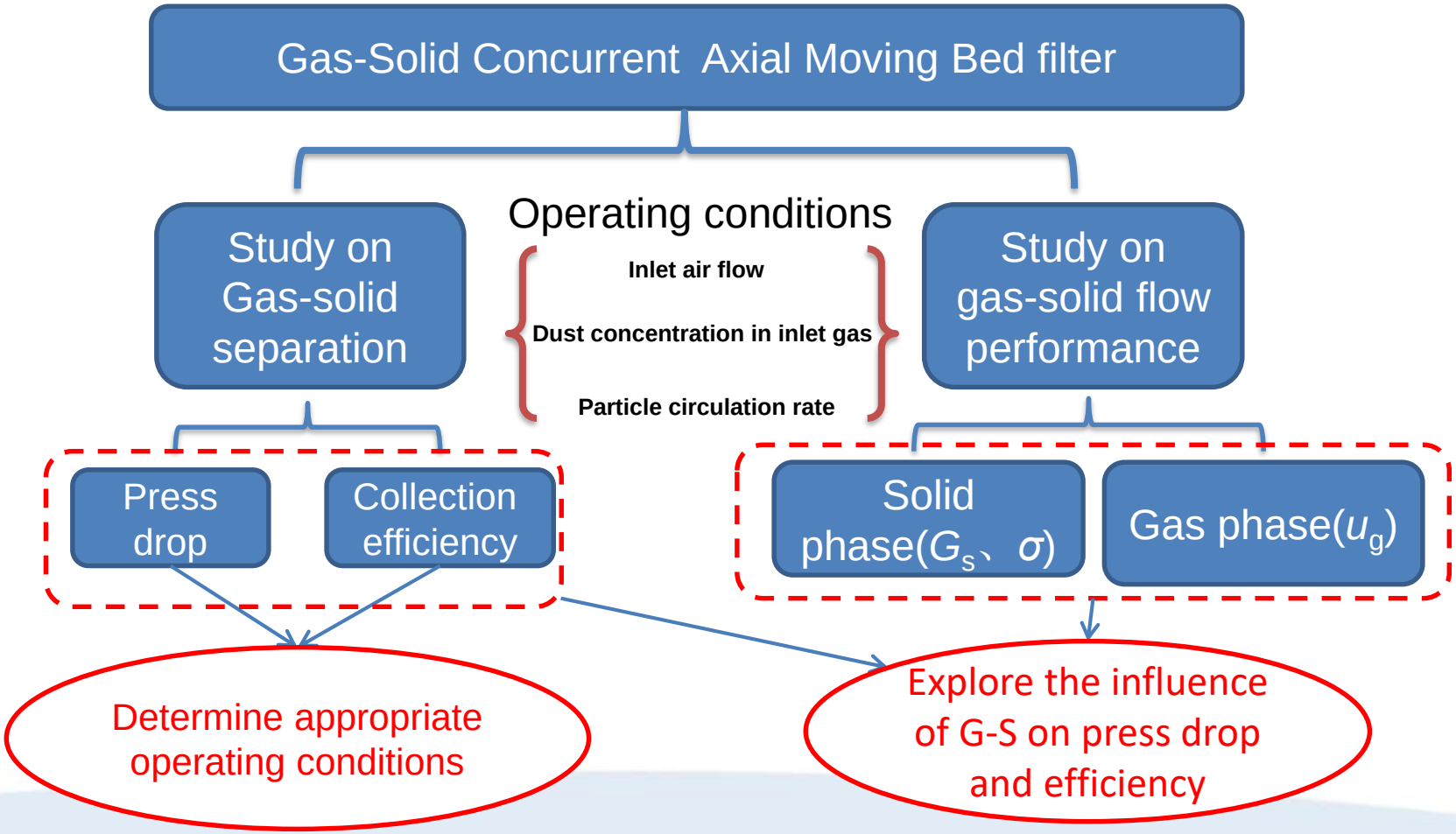
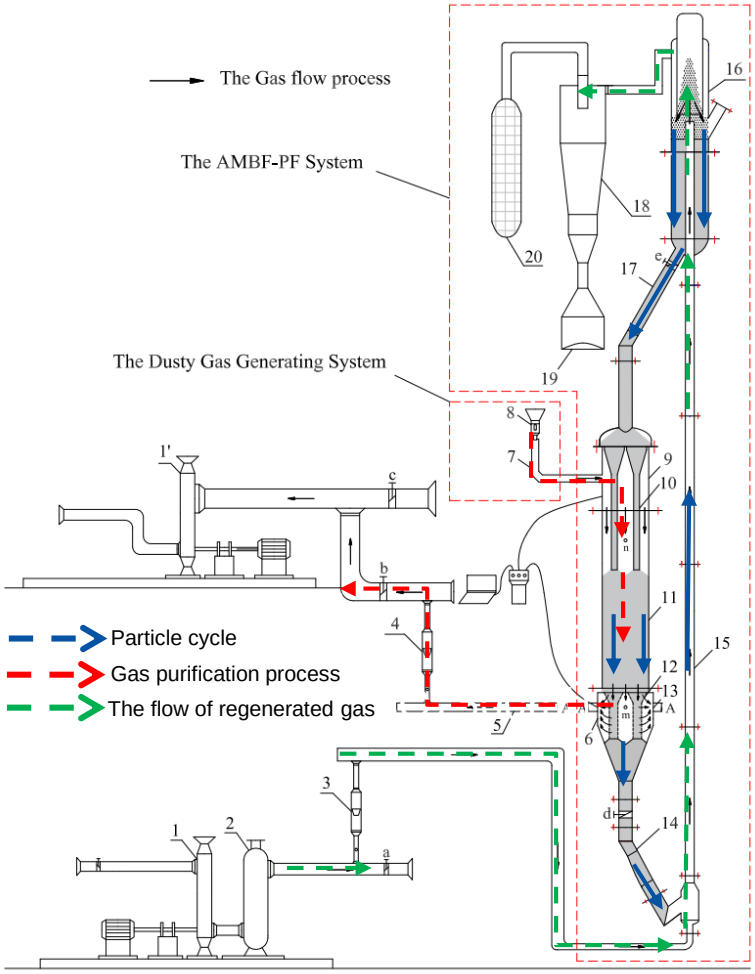
3.1 Framework of technical line



3.2 Experimental process



1.Blower;
1'.Induced draft fan;
2.Gas buffer tank;
3.Riser flowmeter;
4.Air inlet flowmeter;
5.Outlet pipeline;
6.Exhaust chamber;
7.Inlet pipeline;
8.Screw feeder;
9.Air inlet chamber;
10.Upper feeding cone;
11.Moving bed body;
12.Guide cone;
13.The screen;
14.Pending inclined pipe;
15.Riser;
16.Jet regenerator;
17.Regenerated inclined pipe;
18.Cyclone separator;
19.The hopper;
20.Dust filter bag.
a. Blower blow-off valve;
b. Pressure control valve of induced draft fan;
c. Pressure relief valve of induced draft fan;
d. Raw valve; e. Regenerative valve.

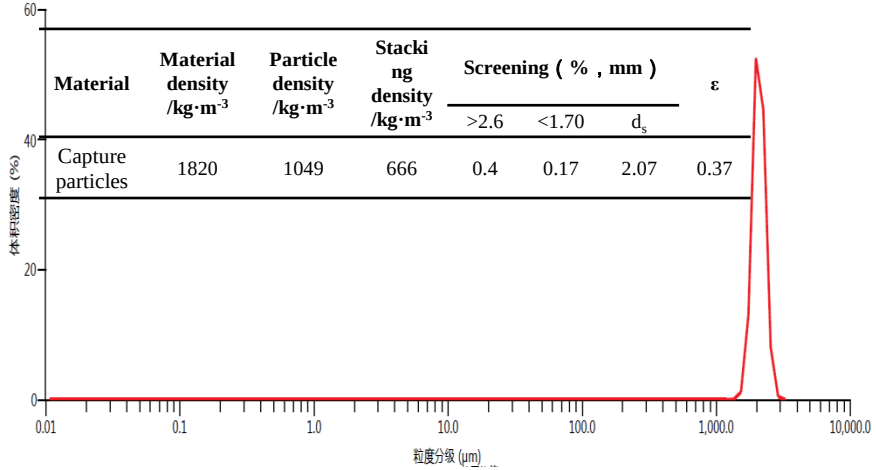
3.3 Experimental medium and dust properties:

Gas：Air constant temperature, pressure

Capture particles：UOP 13X-APG

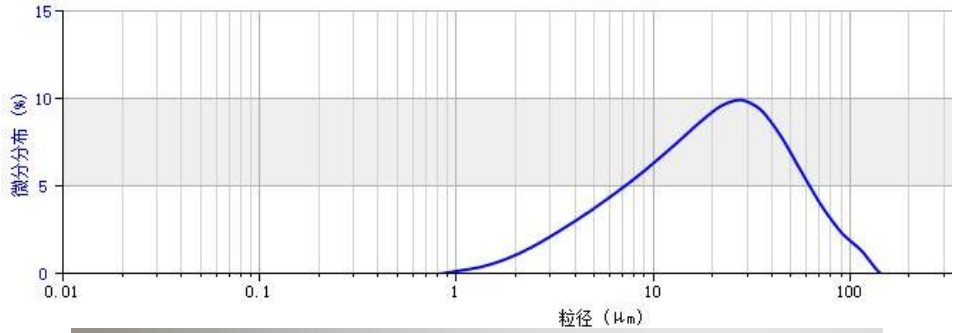
molecular sieve adsorbent

Material	Material density /kg·m^{-3}	Particle density /kg·m^{-3}	Stacking density /kg·m^{-3}	Screening (% , mm)			ε
				>2.6	<1.70	d_s	
Capture particles	1820	1049	666	0.4	0.17	2.07	0.37



UOP 13X-APG Molecular sieve adsorbent particle size distribution curve（Mastersizer3000）

Dust particle size distribution（~19μm）



LS-909 Laser particle size analyzer

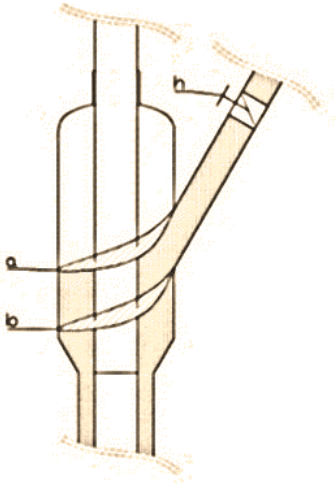
3.4 Main contents and methods of experiment:

(a) The press drop of bed

HengXin AZ82062 type digital display differential pressure gauge

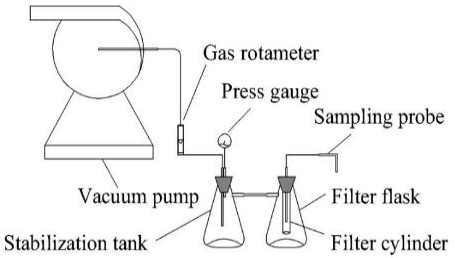
(b) Particle circulation rate

Volume method



(d) Dust capture efficiency

Isokinetic sampling



(e) Particles move speed

PV-6M Particle velocity measuring instrument

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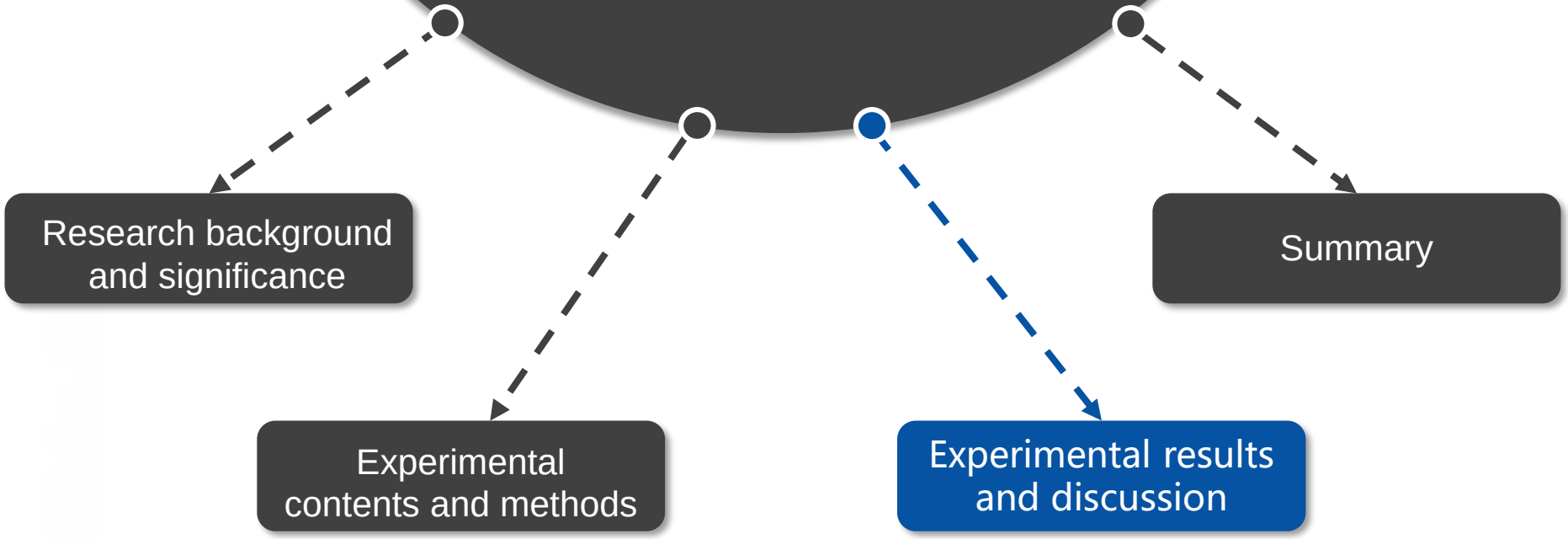
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1、 Pressure drop of equipment under dust-free load

（1）Relationship between superficial gas velocity(u_g) and bed pressure drop

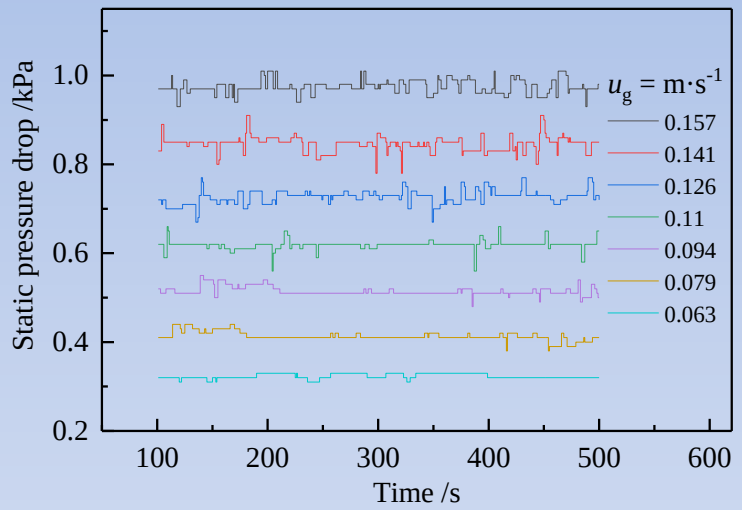

Fig.1 Variation diagram of static pressure drop of equipment with time under different superficial gas velocities (G_s=0)

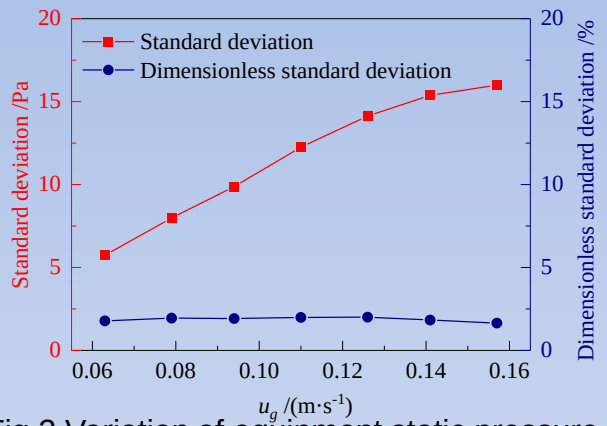

Fig.2 Variation of equipment static pressure drop standard deviation and dimensionless standard deviation with superficial gas velocity

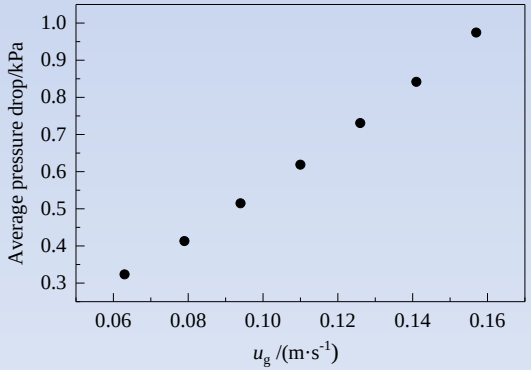

Fig.3 Relationship between mean static pressure drop and apparent gas velocity (G_s=0)

Analysing

- 1. The bed static pressure drop increases with the increase of superficial gas velocity；
- 2. The fluctuation of static pressure difference is small and the operation is relatively stable；
- 3. The static pressure drop of the device is a quadratic function of the superficial gas velocity.

（2）Experimental results and Ergun formula fitting results

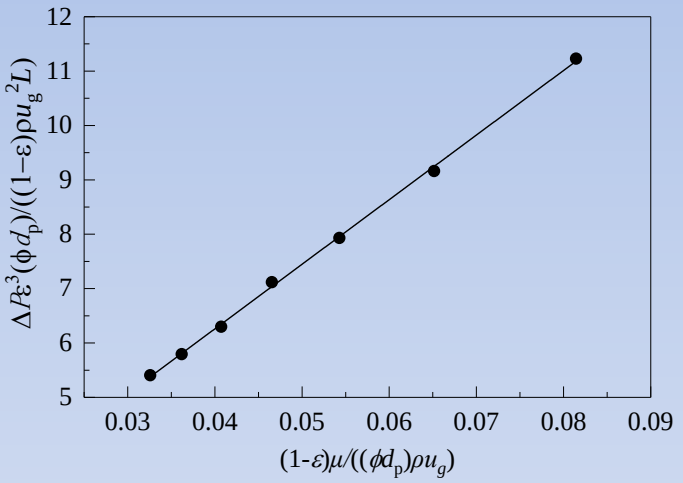

Fig.4 Fitting results of Ergun formula

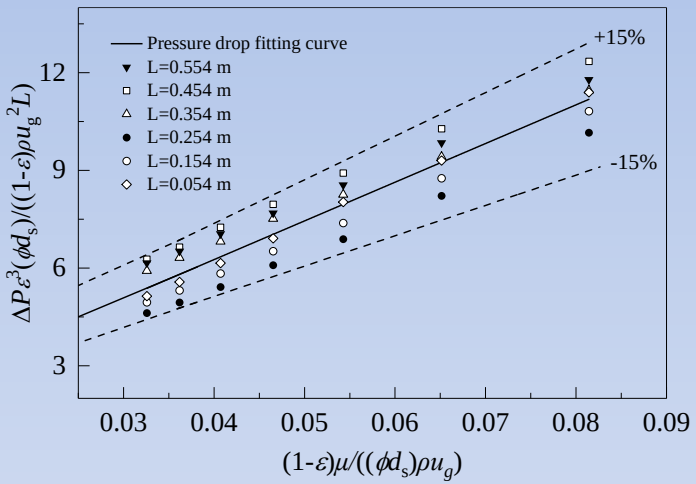

Fig.5 Comparison of experimental results and Ergun formula fitting results

Discussing

- Fitting results of Ergun formula: $\frac{\Delta P}{L}=121.9\frac{(1-\varepsilon)^2}{\varepsilon^3}\frac{\mu u_g}{(\phi d_p)^2}+1.34\frac{(1-\varepsilon)}{\varepsilon^3}\frac{\rho u_g^2}{\phi d_p}$
- The error between all measured pressure drop data and fitting curve is less than 15%.

（3）Effect of particle circulation rate on pressure drop

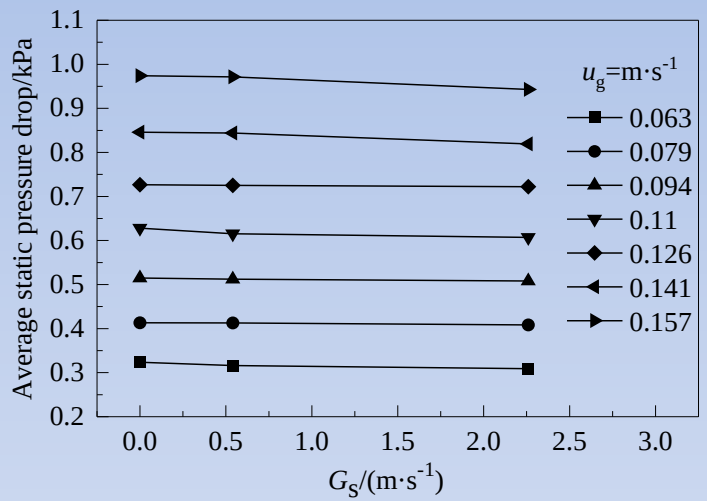

Fig.6 Influence of particle movement rate on device pressure drop

As can be seen from the figure, when the particle circulation rate increases from 0 to 2.26 kg/(m2·s), the bed pressure drop decreases slightly. But the decline was smaller, about 25Pa.As the bed circulation increases, the interparticle porosity increases, leading to a slight decrease in the bed pressure drop.

2、 Pressure drop of equipment under dust load

（1）Press drop of equipment under fixed bed operating conditions

Fig.7 Schematic diagram of dust accumulation on top of the bed

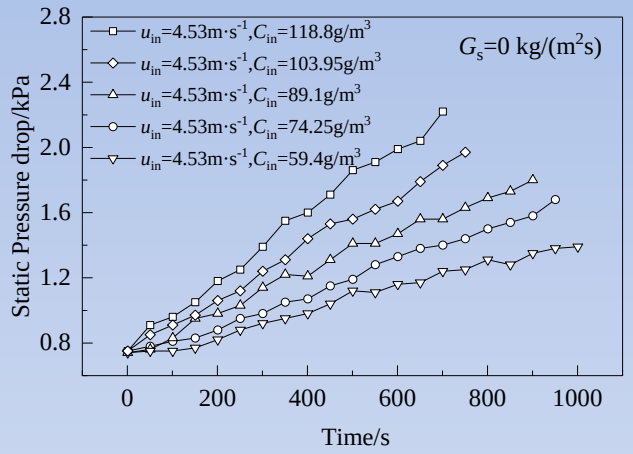

Fig.8 Variation of equipment pressure drop with operation time

- Dust would be **intercepted** by the particle from the top of the bed and accumulates on the bed.
- Cause the increasing of the press drop. With the increasing of dust concentration in the inlet, the rate of press drop increase would augment.

（2）Device press drop at different particle circulation rates

- Fig. 9 shows the relationship between the press drop of the bed under the three cycle rates over time. When the cycle rate is low (0, 0.54kg /(m^2·s)), the pressure drop of the equipment is generally in an increasing trend.
- When the cycle rate reaches the high level（2.26kg/(m^2·s)）, the pressure drop of the equipment increases first and then becomes stable.

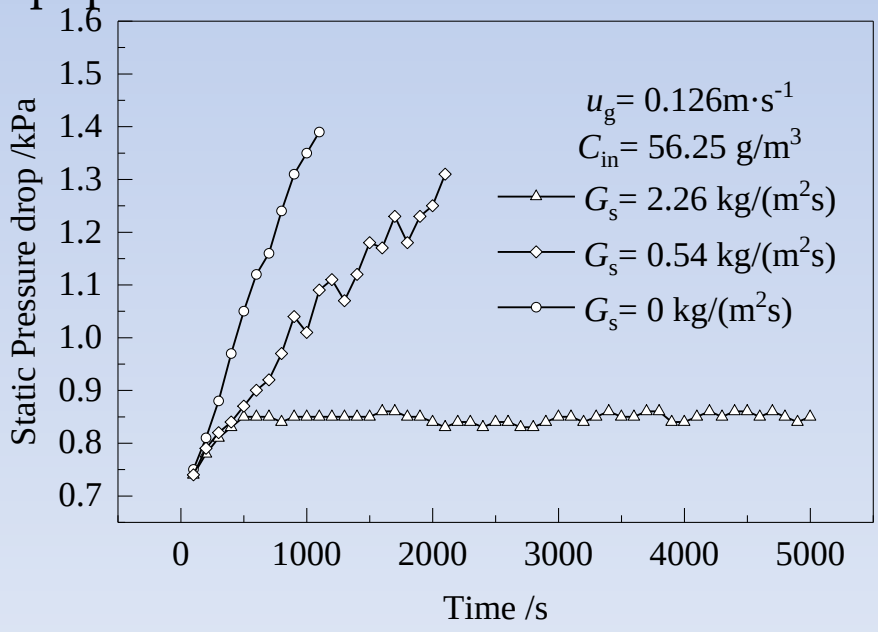

Fig.9 The changes of pressure drop with time under three cycle rates

（3）The pressure drop of bed changes with deposition rate under dusting condition

- As the filtration progresses, the pressure drop of the equipment increases first and then gradually stabilizes.
- The pressure drop increases with the increase of specific deposition rate when the device reaches a stable state.
- When the specific deposition rate reaches and the filtration operation is 4500s, the equipment has gas channeling and bridging. The equipment cannot guarantee long cycle operation.

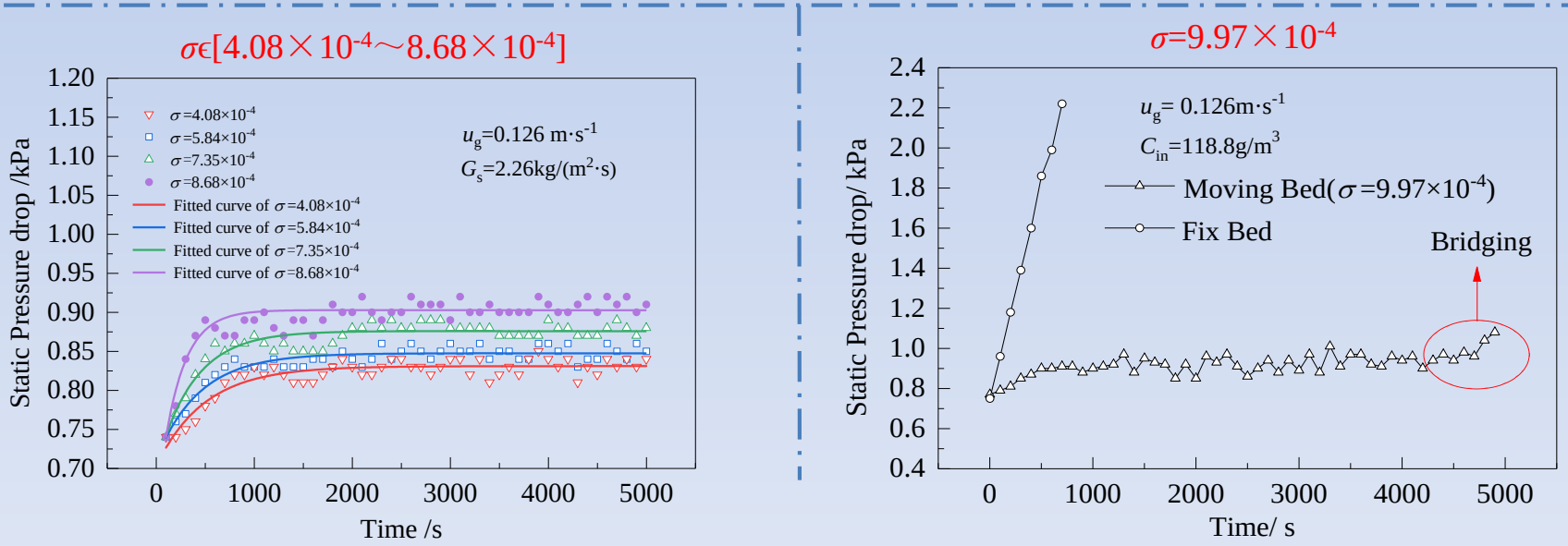

Fig.10 Pressure drop changes with filtration operation under different deposition rates

（4）Effects of deposition rate and superficial gas velocity on the collection efficiency

- With the increase of the deposition rate, the capture efficiency of the equipment increases first and then decreases gradually. When the specific deposition rate is within the range of 5.84×10^{-4} ~ 7.35×10^{-4}, the dedusting performance of the equipment is the best, and almost all of them can reach more than 97%.
- The superficial gas velocity has a great influence on the capture efficiency. The larger the superficial gas velocity, the smaller the capture efficiency of the moving bed filter is.

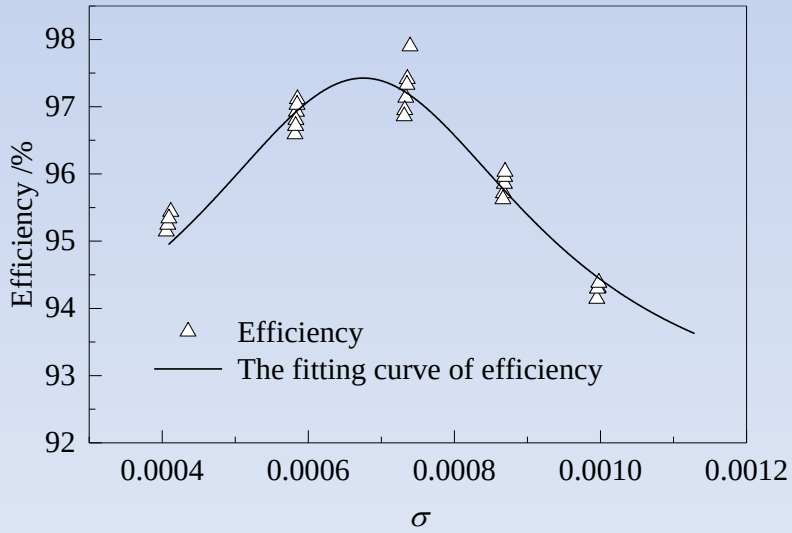

Fig.11 Relation of capture efficiency and deposition rate

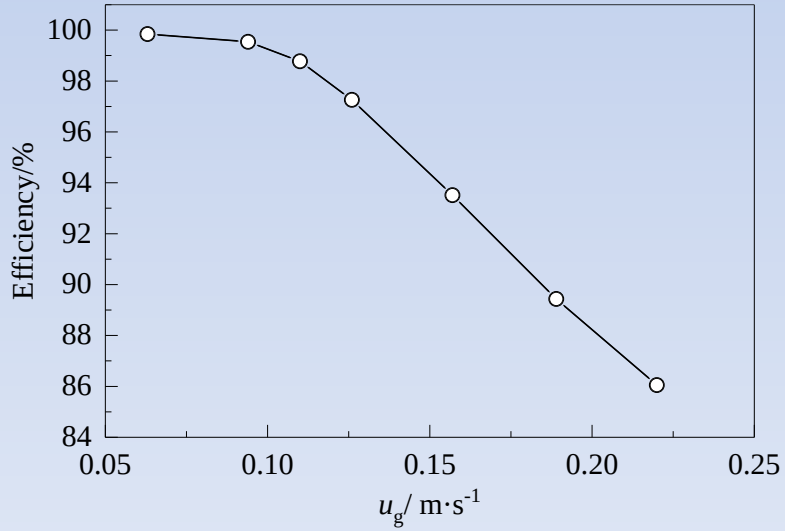

Fig.12 Variation of device capture efficiency with superficial gas velocity

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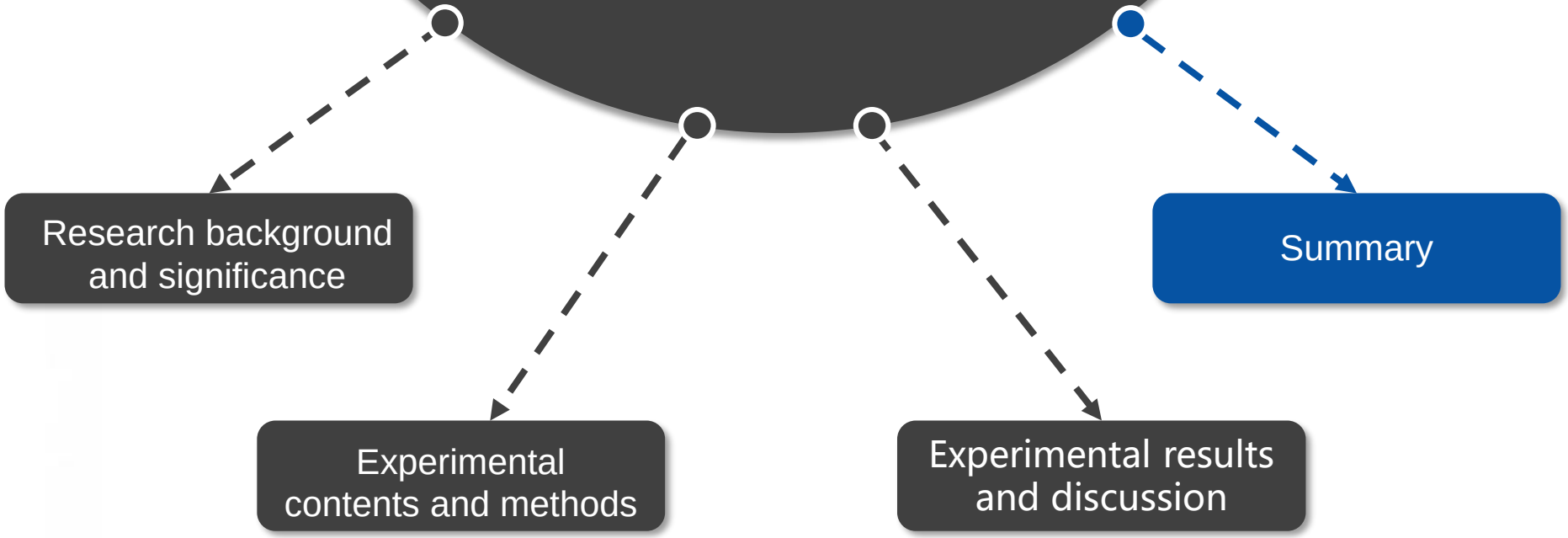
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This study studied the pressure drop and dust removal efficiency of gas-solid parallel flow axial moving bed filter under different operating conditions. The results showed that the superficial gas velocity and specific deposition rate had significant influence on the moving bed filter.

High or low specific deposition rate is not conducive to stable operation of the equipment.

The results show that when the apparent gas velocity ug is 0.126m/s and the deposition rate σ is 0.000735, the filter has the highest pressure drop stability and highest efficiency.

Thanks For Your Listening!