



25th world gas conference
"Gas: Sustaining Future Global Growth"

Research Progress on Gas Interchangeability in China

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China Gas Society
7 June, 2012
Malaysia



Patron



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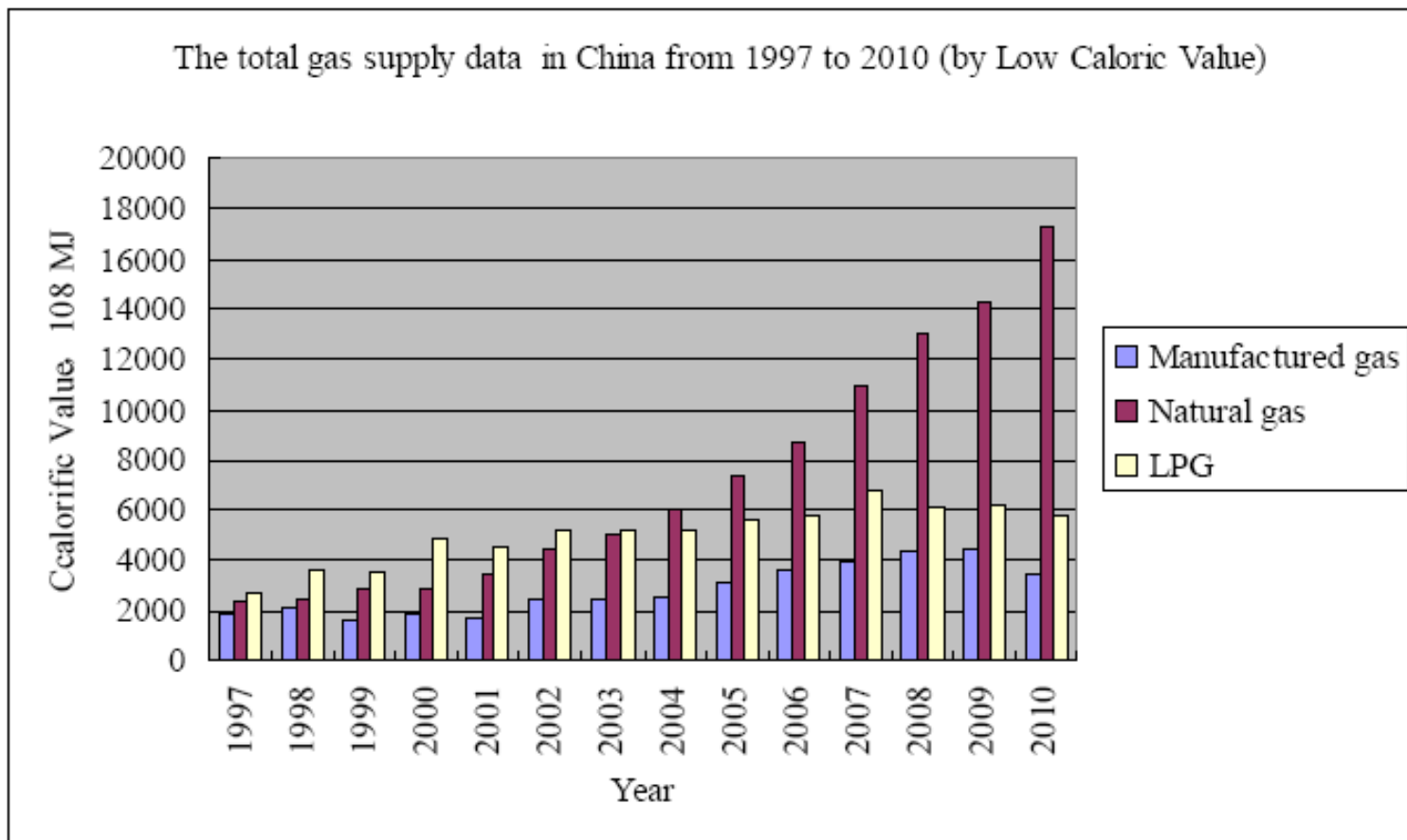
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1 Background



1 Background

- **Multi-source gases** entering the same distribution network system.
- **Gas Shortage**, alternative and peak shaving gas demands.
- **Combustion properties of gas end use equipments** differs.

2 Overview of gas interchangeability method in China

- In 1982, China issued the first national standard of Classification of town gas.
- Gas interchangeability parameters of atmospheric appliances used are **Wobbe Index, Heating Value, Combustion Potential, Yellow Tip, Coking Index.**
- We are studying new combustion parameters of gas, other than WI, HV, CP, YT, etc.
- Large numbers of experiments and tests have been done.

2 Overview of gas interchangeability method in China

National standards on city gas classification and interchangeability



2006-09-12发布 2007-03-01实施
中华人民共和国国家质量监督检验检疫总局 发布
中国国家标准化管理委员会



2 Overview of gas interchangeability method in China

Classification of Natural gas

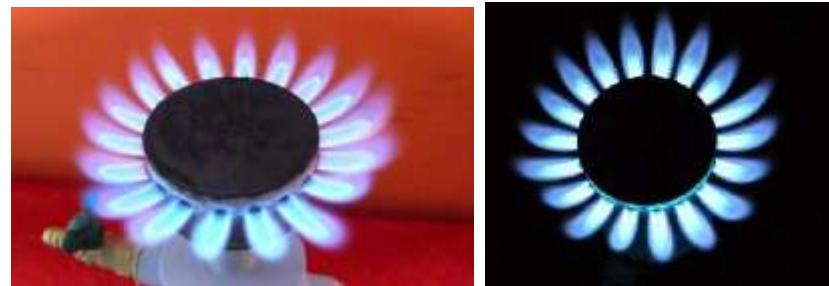
Gas group	Test gases	Composition by volume, %	Relative density d	Heating value, MJ/m ³		Wobbe index, MJ/m ³		Combustion potential CP	CO ₂ component by volume in dry fumes, %	
				H _i	H _s	W _i	W _s			
Natural Gas	3T	0	CH ₄ =32.5, air=67.5	0.855	11.06	12.28	11.95	13.28	22.0	11.74
		1	CH ₄ =34.9, air=65.1	0.845	11.87	13.19	12.92	14.35	22.9	11.74
		2	CH ₄ =16.0, H ₂ =34.2, N ₂ =49.8	0.594	8.94	10.18	11.59	13.21	50.6	6.27
		3	CH ₄ =30.1, air=69.9	0.866	10.24	11.37	11.00	12.22	21.00	11.74
	4T	0	CH ₄ =41, air=59	0.818	13.95	15.49	15.43	17.13	24.9	11.74
		1	CH ₄ =44, air=56	0.804	14.97	16.62	16.69	18.54	25.7	11.74
		2	CH ₄ =22, H ₂ =36, N ₂ =42	0.553	11.16	12.67	15.01	17.03	57.3	7.40
		3	CH ₄ =38, air=62	0.831	12.93	14.36	14.19	15.75	24.0	11.74
	6T	0	CH ₄ =53.4, N ₂ =46.6	0.747	18.16	20.18	21.01	23.35	18.5	10.65
		1	CH ₄ =56.7, N ₂ =43.3	0.733	19.29	21.42	22.53	25.01	19.9	10.77
		2	CH ₄ =41.3, H ₂ =20.9, N ₂ =37.8	0.609	16.18	18.13	20.73	23.23	42.7	9.36
		3	CH ₄ =50.2, N ₂ =49.8	0.760	17.08	18.97	19.59	21.76	17.3	10.51
	10T	0, 2	CH ₄ =86, N ₂ =14	0.613	29.25	32.49	37.38	41.52	33.0	11.52
		1	CH ₄ =80, C ₃ H ₈ =7, N ₂ =13	0.678	33.37	36.92	40.53	44.84	34.3	11.92
		3	CH ₄ =82, N ₂ =18	0.629	27.89	30.98	35.17	39.06	31.0	11.44
	12T	0	CH ₄ =100	0.555	34.02	37.78	45.67	50.73	40.3	11.74
1		CH ₄ =87, C ₃ H ₈ =13	0.684	41.03	45.30	49.61	54.78	41.0	11.53	
2		CH ₄ =77, H ₂ =23	0.443	28.54	31.87	42.88	47.88	69.3	11.01	
3		CH ₄ =92.5, N ₂ =7.5	0.586	31.46	34.95	41.11	45.67	36.3	11.63	

Note: 3T or 4T is from mine gas, and 6T is from biogas, the characteristics of which is close to that of natural gas.

---Selected from GB/T 13611-2006 “Classification and essential property of city gas”.

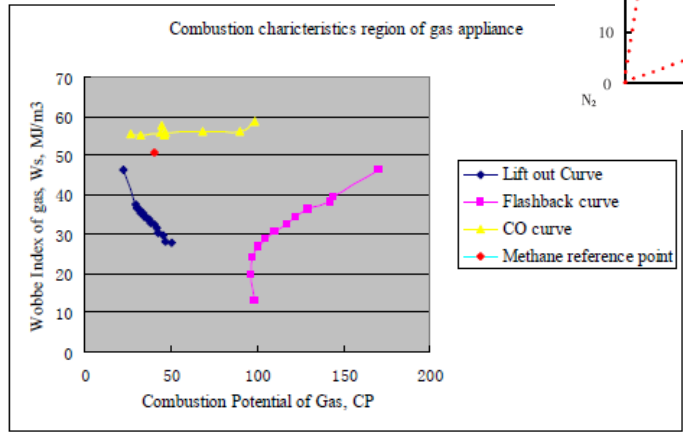
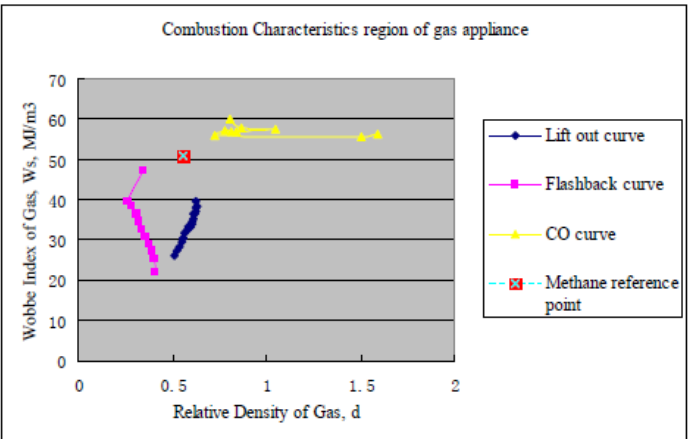
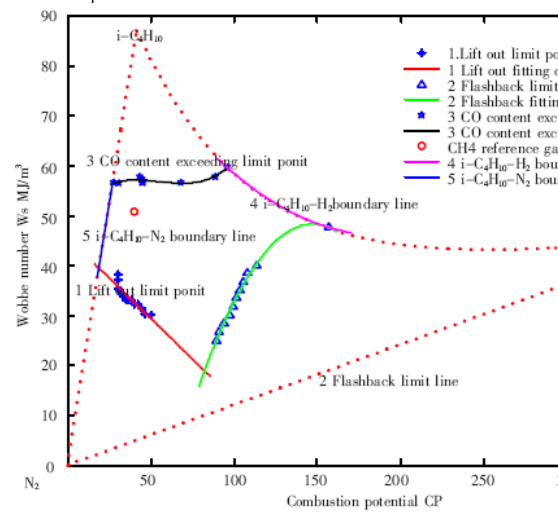
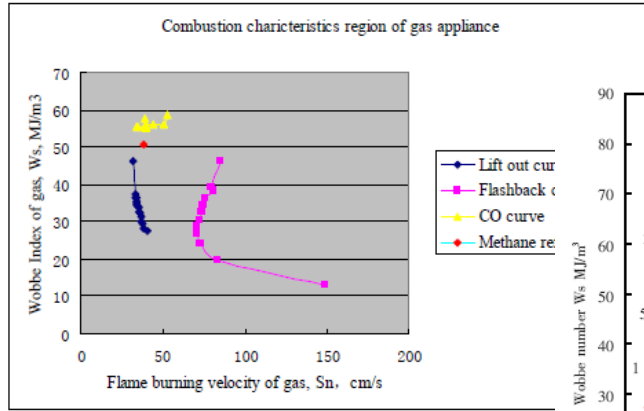
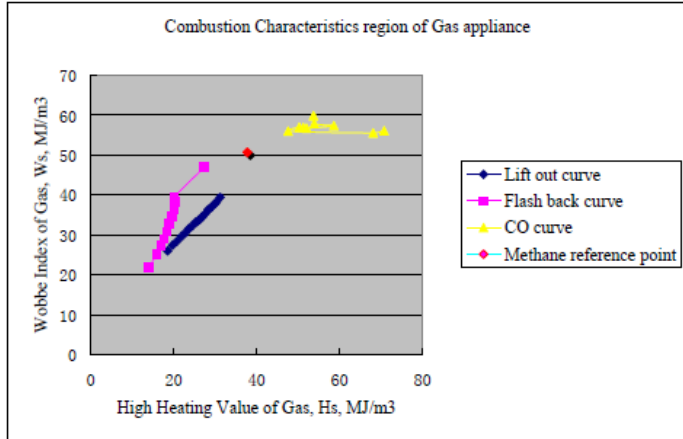
- **3.1 Combustion characteristics-related parameters of gas appliances**
- **3.1.1 Atmospheric (Partial-premixed type) burners**
- Combinations of parameters tested
 - WI-HHV;
 - WI-d;
 - WI-Sn;
 - WI-CP.
- **Combustion parameters are suitable**
 - Wobbe Index (WI);
 - Combustion Potential (CP);
 - Yellow tip Index (YI).

Indexes to describe
the performance
of gas
appliances ?



3 Research and practice of city gas interchangeability

3.1.1 Atmospheric (Partial-premixed type) burners



3.1.2 Fully-premixed combustion type burners

- Combustion characteristics and emission performances of fully premixed types are closely related to the factors such as:

n_i of gas;

HV;

Air/gas;

MN;

Sn;

n_i , V_i , P_i , and T_i of flue gas;

etc.

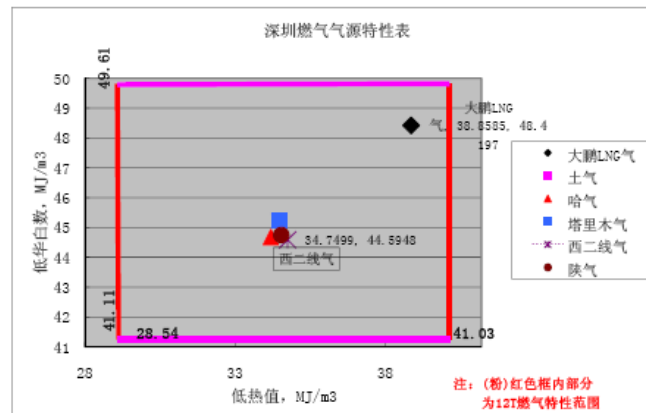
We are testing the parameters to determine this type of gas appliances!



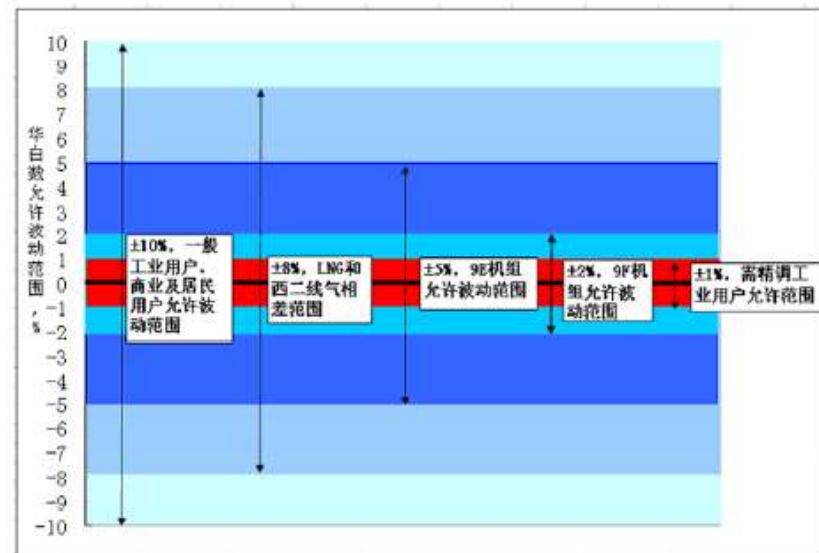
3 Research and practice of city gas interchangeability

3.2 Allocation of city gas sources and methods for gas interchangeability

➤ The methods for urban gas sources allocation and multi-gas interchangeability is advanced.



Gas interchangeability box of certain city, China

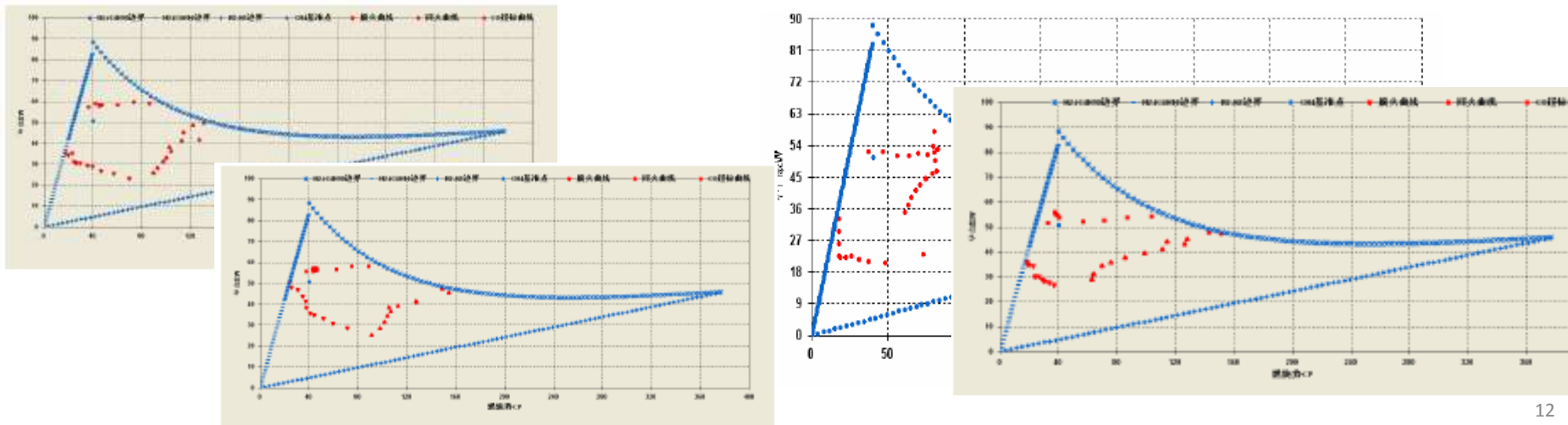


Fluctuation ranges of gas required by different users in certain city

3.3 Experimental research



Fig. 16 Experimental test device of combustion characteristics of gas appliances used in CGAC



3.4 Adaptability of gas appliance

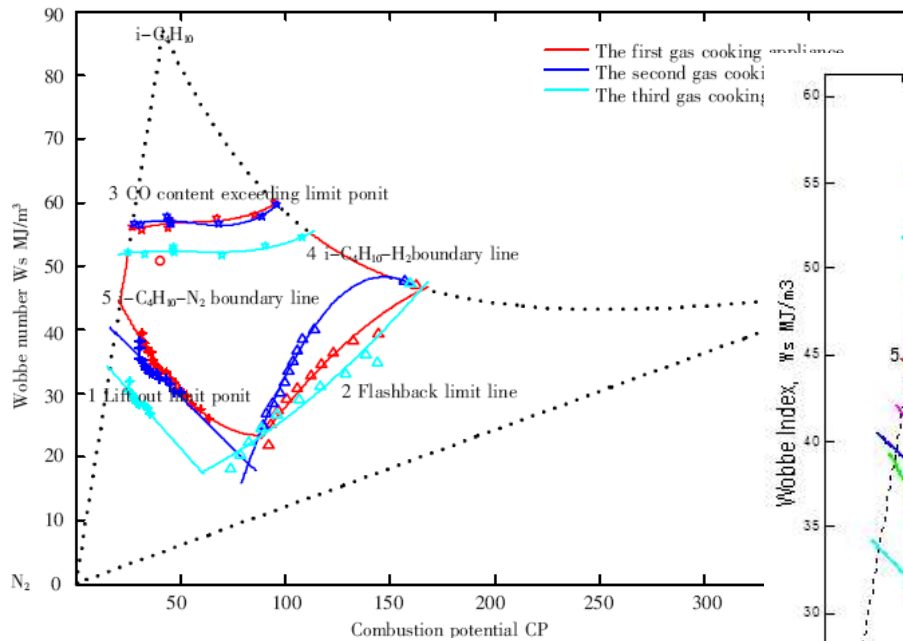


Fig. 19 common adaptability range of three cooking samples

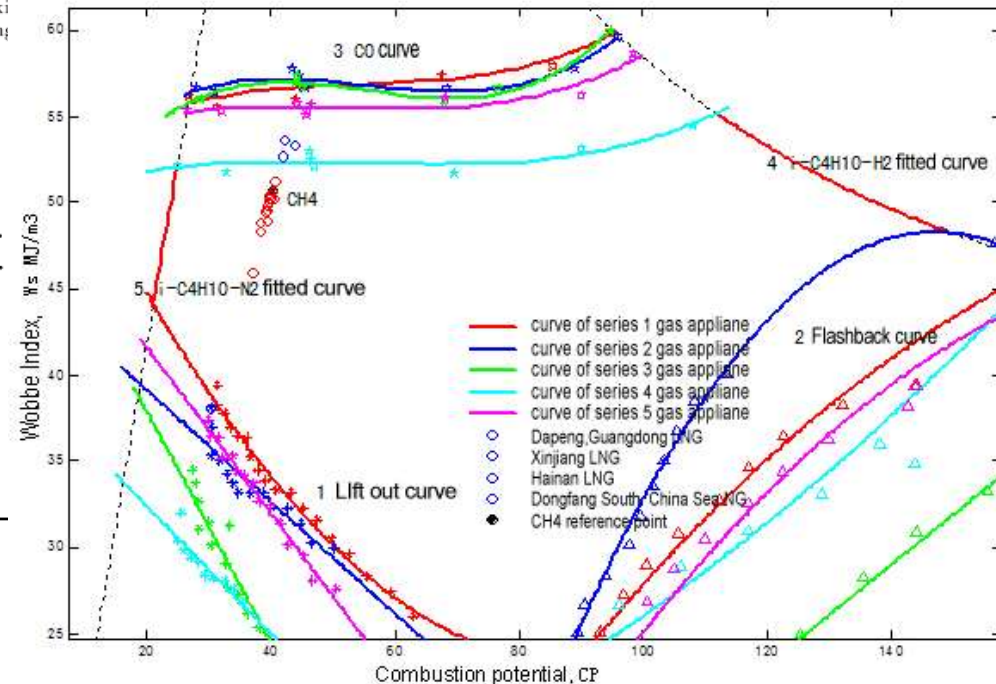


Fig. 20 Typical gases used in China distributed in common adaptability range of different series of gas appliances

3.5 Technical and economical evaluation on city gas interchangeability

- Cost-benefit analysis should be carried out.
- Appropriate reference gas composition and allowable range are selected.
- “Gas map “of local or national adjustment gases can be established.
- City gas allocation and multi-gas interchangeability are progressed.

4. Results

- ◆ Determining method for urban reference gas.
- ◆ Experimental determination of adaptability range of gas appliances and interchangeability range of city gases.
- ◆ Experimental determination of main parameters for representing atmospheric combustion burners.
- ◆ Urban gas interchangeability research route by balanced from technicality and economy.

5. Summary/Conclusions

- With the diversification of gas combustion and non-combustion end-use models, technical parameters and controlling indexes of gas interchangeability should be **reasonably chosen**.
- More experimental researches and technical feasibility studies should be carried out, to build **a comprehensive and scientific technical system of city gas interchangeability**.

Thank You !

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