Biomass stove for solid waste processing in remote areas

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Biomass stove for solid waste processing in remote areas

- Characteristics of remote areas solid waste
- Historical development of biomass stoves
- Stove Usage Status
- Improved experimental design of semi-gasified biomass cooking stoves

Characteristics of remote areas solid waste

Characteristics of remote areas solid waste

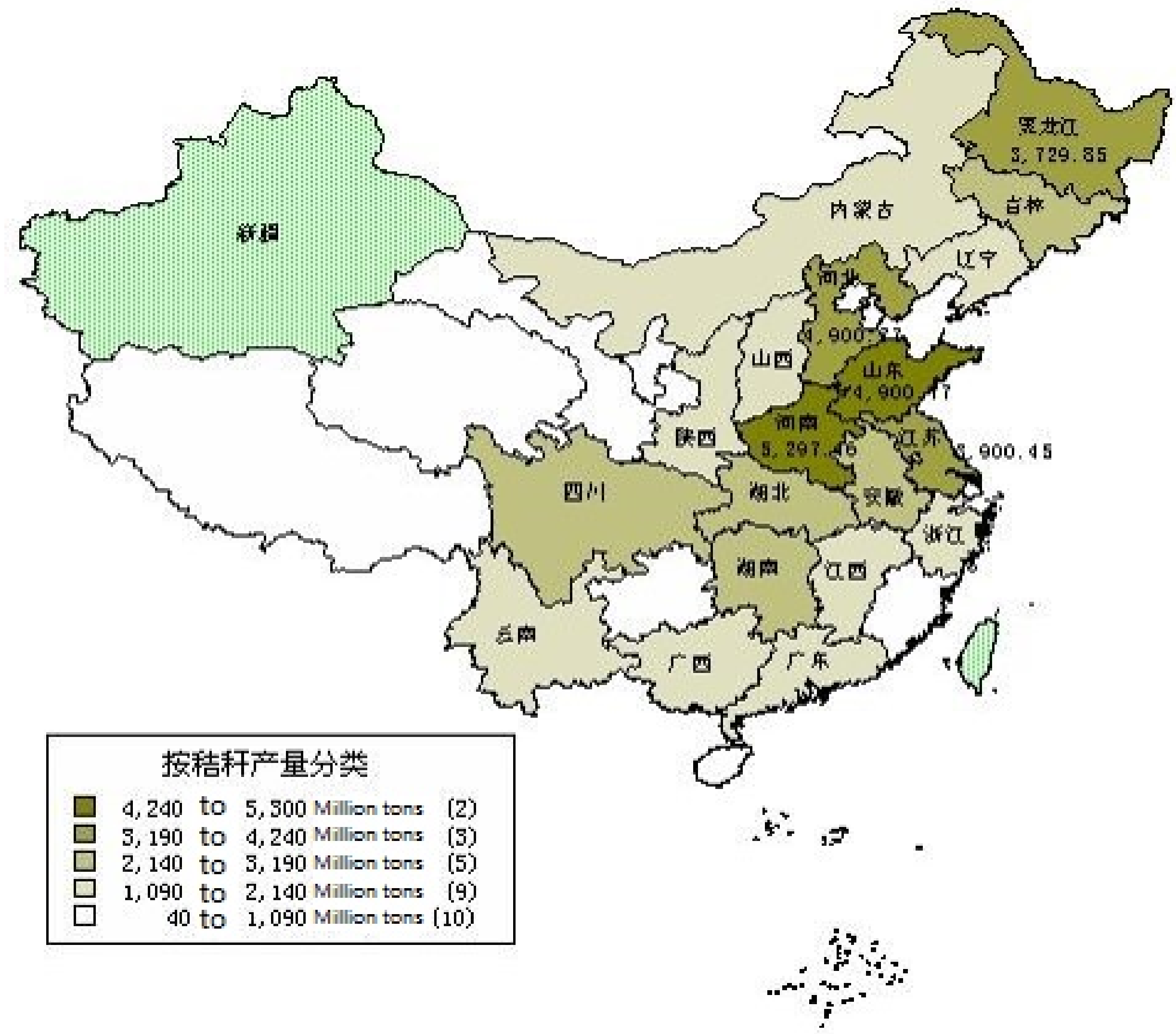
- The size and composition of the waste are big
- The main pollutants are difficult to to degrade
- The wastes cannot be centrally managed like cities

Characteristics of remote areas solid waste

Solid waste in remote areas

- Rural household waste
- Agricultural solid waste
- Industrial solid waste of township enterprises
- Other Solid Wastes

Distribution of solid biomass resources in China



Agricultural surplus:
700 million tons
Forestry residue:
200 million tons

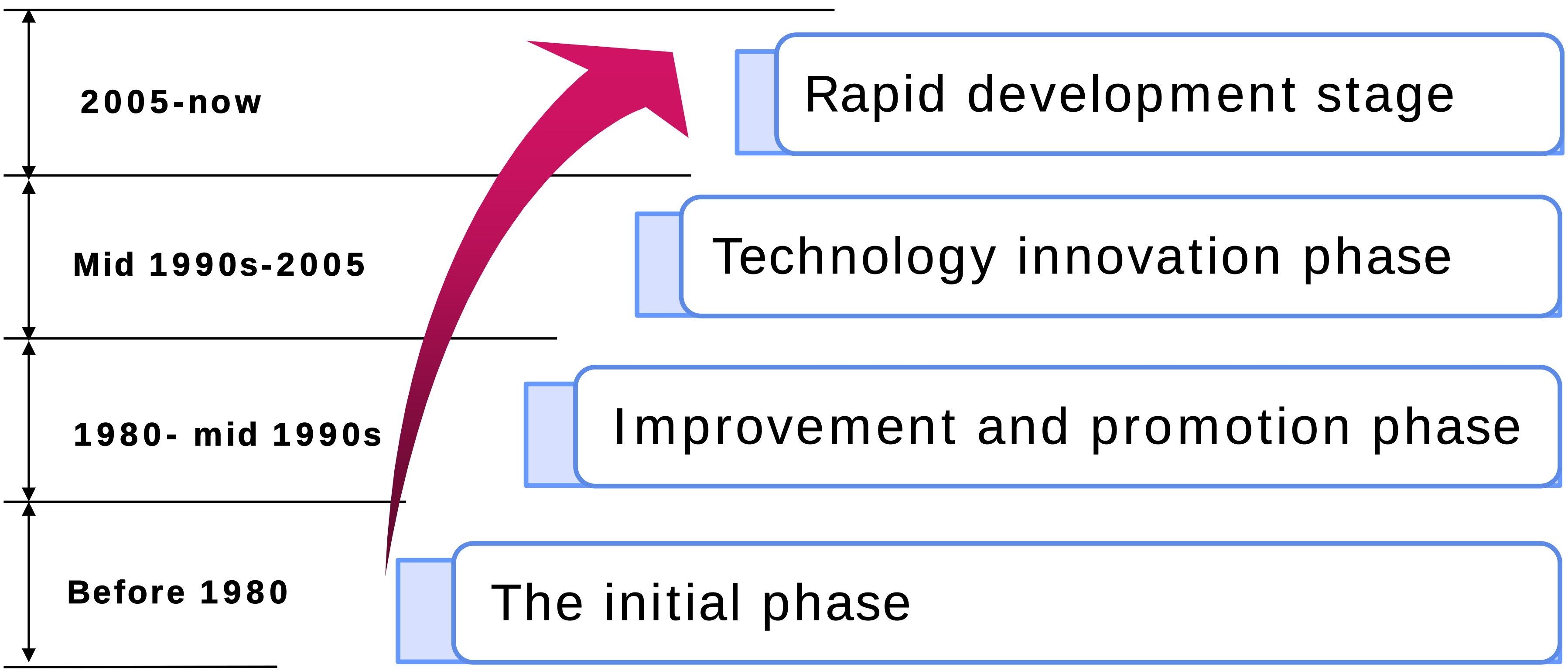
open pit

open burning

Haze

Historical development of biomass stoves

Historical development of biomass stoves



The initial phase

The initial phase of the biomass stove development (before1980)

Before the 1980s, most of China's rural households used the traditional old stove which is artificially made of bricks and stones by farmers.

The main problems are high flame height, big stove door, big furnace, no grate, this will not only cause serious environmental pollution and also damage to human health, but also will lose a lot of heat energy. The thermal efficiency is very low at about 12%.

Improvement and promotion phase

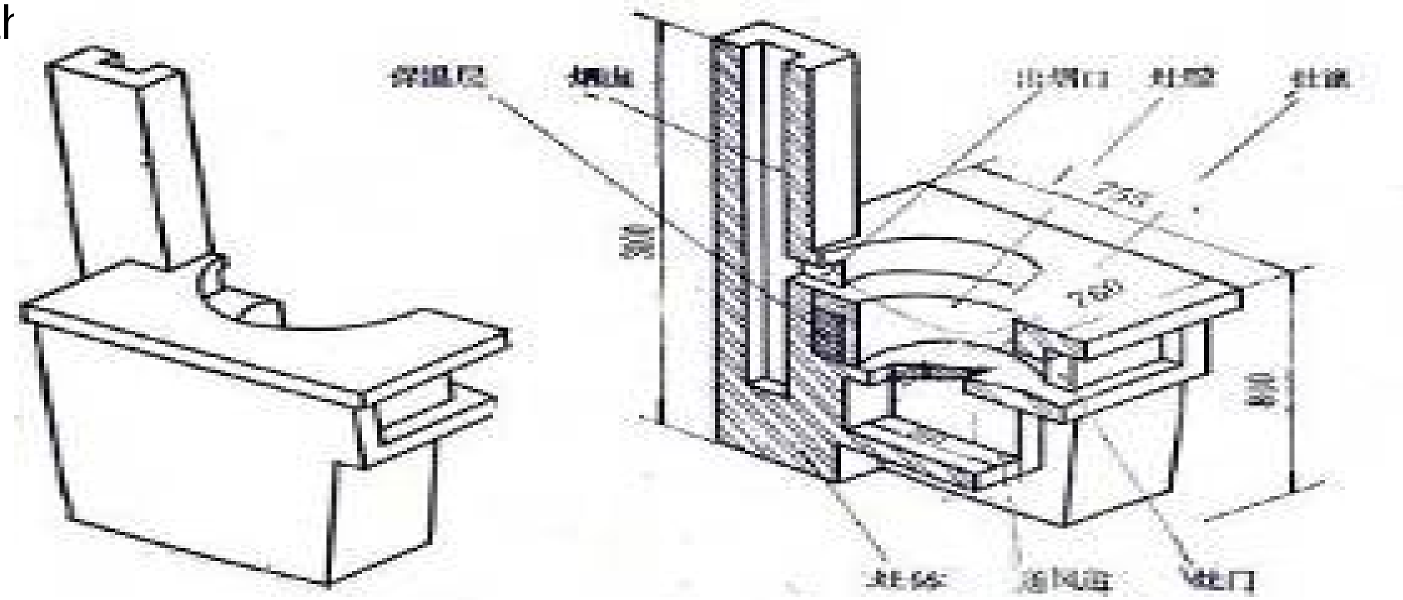
Biomass stove improvement and promotion phase (1980s – mid-1990s)

Promote the fuel-saving stoves

In early 1980s, Chinese government has planned to carry out the work of changing stoves and saving firewood in pilot counties in rural areas and has also included it in the Sixth Five-Year Plan.

Stoves connected to kang (a heatable brick bed)

Most of people in the northern region have transformed the traditional kang to th



Technology innovation phase

Biomass stove technology innovation phase (the mid-1990s – 2005)

Straw gasified stoves

High efficiency and low-emission biomass stoves

- Thermal efficiency: cooking stove> 35%
- cooking and heating stove> 60%
- heating stove> 65%
- SO2 emission concentration <30mg / m3
- NOx emission concentration <150mg / m3





Rapid development stage

Rapid development stage (2005-present)

Since 2005, the production scale of stove enterprises has continued to expand. The production capacity of some biomass stove enterprises has been over 30 thousand per year with increasingly higher production rate and gradually enhanced commercialization. And great efforts have been made in the research and development.



Stove Usage Status

Stove Usage Status

The InternationalEnergyAgency estimates that there will be still 280 million people depending on solid fuels for cooking and heating.

Different types of stoves

Primitive stove

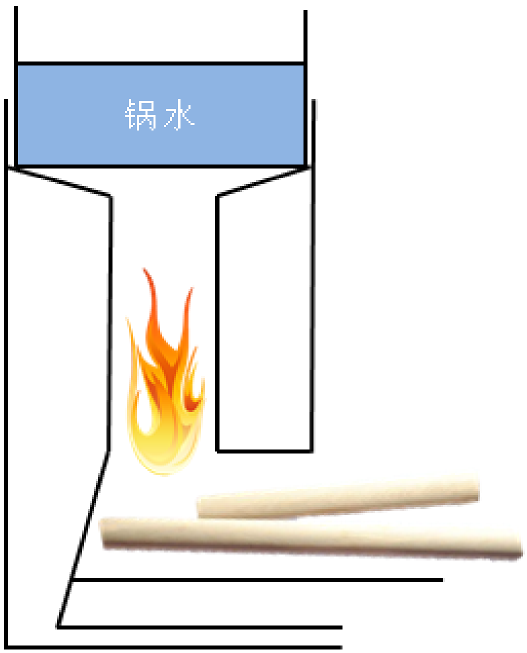
Three-stone stove is a representative of the primitive stove which uses three stones to stand up a pot. The burning wood is placed under the pot. This kind of stove is still widely used in some undeveloped or underdeveloped areas such as in Africa and some parts of Asia. But because of the bad circulation, there will be a large amount of smoke due to the incomplete combustion. Such stoves are greatly influenced by the wind and cannot concentrate the heat when used outside.

Different types of stoves

Traditional stove

The traditional stoves are mostly made of clay and brick by farmers. At present, the traditional stoves are being widely used around the world such as China's rural mud stove, Indian mud stove, South American baking pan stove, etc. The main fuel is straw and firewood. These stoves are usually made by people according to their experience and have very low thermal efficiency. But comparing to the primitive stoves, their performance has already get significantly improved.

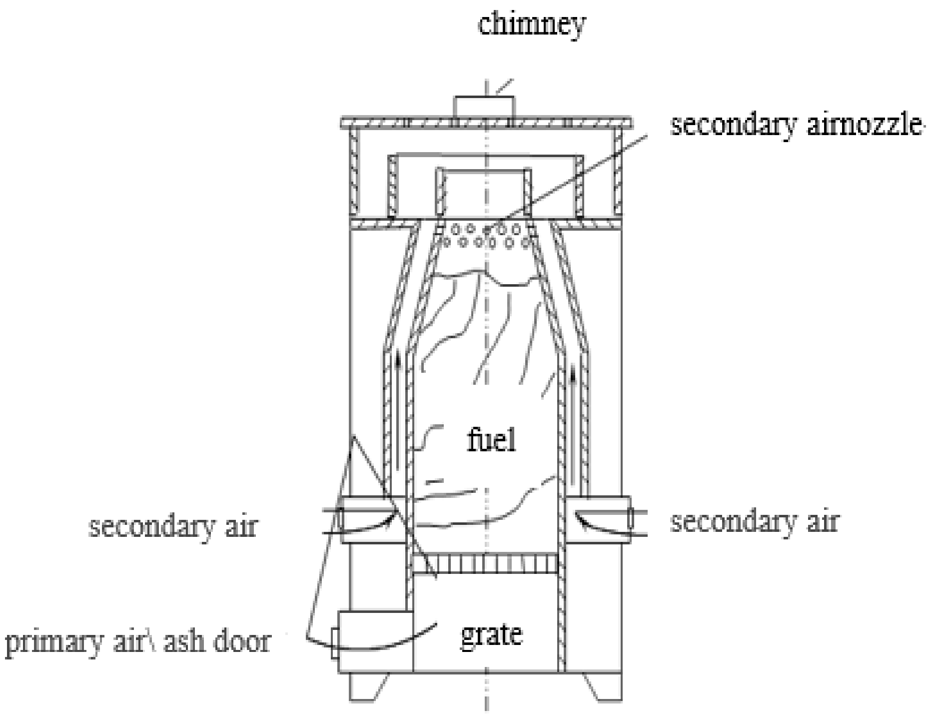
Different types of stoves



Rocket stove

The most primitive rocket stove was invented in 1982 , and the main fuel is wood. When using, ignite one end of the wood and put it on the rocket stove grate through the side. Under the grate, there is also some space connected to the outside to let the primary air in. The wood is heated and gets burned inside the combustor and mixed with secondary air to produce a flame. During the using process, we need to push the wood slowly inside. The construction of the rocket stove is simple and easy to use. It has been widely promoted in Africa, North America and other places.

Different types of stoves



semi-gasified stove

In last century, the batch feeding and top ignition type semi-gasified stove (see Figure 1-5) began to appear in China. This stove’s feature is to apply trans-combustion technology and achieve a clean and efficient combustion effect by controlling the air inside the combustor.

Improved experimental design of semi-gasified biomass cooking stoves

International workshop agreements

thermal efficiency:

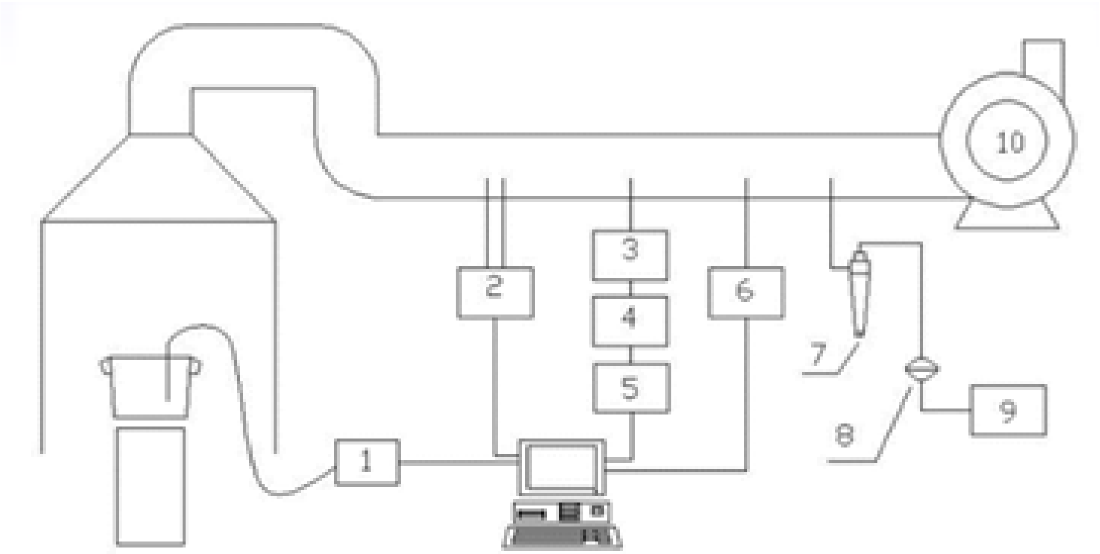
thermal efficiency:（%）	15%	25%	35%	45%	
0level	1level	2level	3level	4level	

High thermal strength PM emissions:

PM emissions:：（mg/MJd）	979	386	168	41	
0level	1level	2level	3level	4level	

Main factors				
	thermal efficiency	Low thermal intensity burning rate	High thermal strength CO emission	Low thermal strength CO emission
	Low thermal strength PM2.5 emission	High thermal strength PM2.5 emission	Indoor CO emission	Indoor PM2.5emissio n

test equipment



Laboratory Emissions Monitoring System:
1,Temperature measuring thermocouple；2,Currentmeter ； 3,PM detector； 4, Real-time CO detector； 5,CO_2 detector； 6,Flue gas temperature probe； 7,separator； 8, filter membrane； 9, pump； 10,exhaust fan

Xunda C2.0-SW-IIO

Xunda C2.0-SW-IIO

Xunda C2.0-SW-IIO is an air forced biomass semi-gasified stove whose combustor is made of heat resisting materials. The combustor is 18 cm wide and 27cm high. On the top, there is a 12 cm mouth as burners. The stove is equipped with a 12 watt fan.

problems

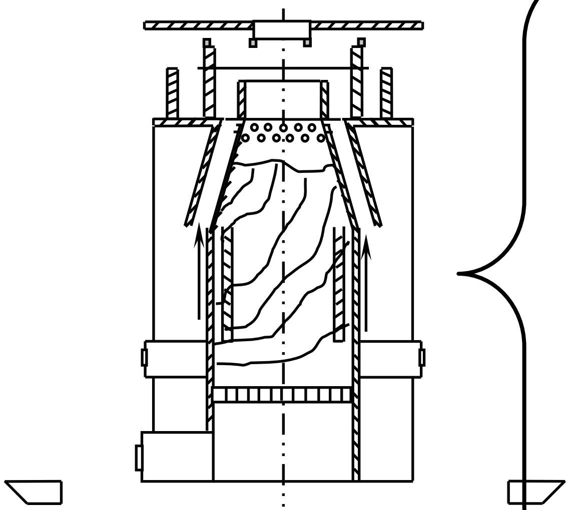
1. The stove has low thermal efficiency. Large amount of heat has lost along with flue emissions. So the stove is lack of effective heat exchange;

2. Some of the charcoal is not burned completely after cooking, which causes fuel waste and is difficult to clean;

3. Sometimes the air is too strong in the charcoal burning process, which results in a lot of smoke and more particulate emissions;

4.The air control system cannot be precisely controlled and will result in pollution.

Affect factors

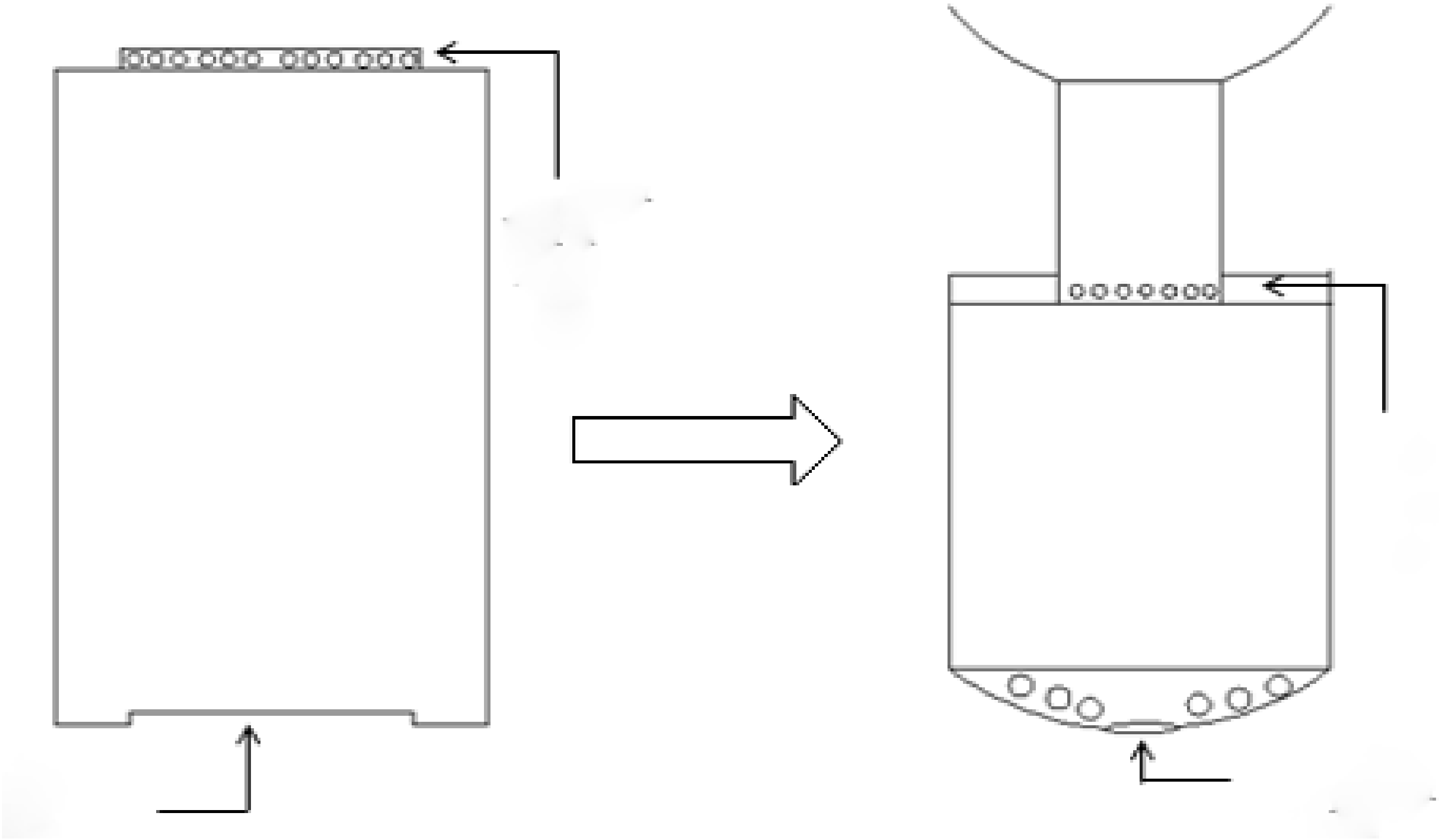


- primary air and secondary air
- space for flame burn
- tube for flue gas
- height of combustion chamber

affect → Stove Performance

- Thermal property
- Emission of CO
- Emission of PM

Improved experimental design



Simplified graph of stove improvement

Performance test of Xunda C2.0-SW-IIO stove after improvement

Parameter	Unit	Average	SD	Level
Thermal efficiency	%	45.79	1.51	4.0
CO Discharge	g/MJd	0.58	0.13	4.9
PM2.5 Discharge	mg/MJd	18.70	2.92	4.5
Indoor CO discharge	g/min	0.07	0.03	4.8
Indoor PM2.5 discharge	mg/min	1.95	0.03	4.0

The heat consumption has decreased by 7% after improvement; carbon monoxide emissions have fallen by nearly 50%; PM2.5 emissions have also reduced by 76%. The overall effect after improvement is very good.

Thank you