

cial fuel, etc. it is a clean fuel. Its pollution from natural gas only is  $\frac{1}{4}$  of liquefied petroleum gas and  $\frac{1}{800}$  of coal.

Coke gas' heat value due to high content of  $H_2$ ,  $CH_4$  and CO in the coke gas is improved through the methanation reaction. Most of CO and  $CO_2$  are converted to  $CH_4$ . Synthesis natural gas (SNG) which includes 90% of  $CH_4$  is obtained after separation. Synthesis natural gas is compressed to become compressed natural gas (CNG) or liquefied natural gas (LNG). There are a lot of advantages listed as follows: save storage space, decrease transportation fees, high heat value and high performance, etc. It is a new type of clean fuel and is widely focused. Most of countries firstly choose LNG as fuel.

### Coke gas as feedstock produces natural gas <sup>[6]</sup>

Figure 2 shows image for process of flow of catalytic oxidation of coke gas.

### CONCLUSION

The coke gas can be used to produce high value chemicals in China. These coke gas based methods protect the environment and increase the income of a petrochemical plant. The main benefits are as follows: protecting the local environment, decreasing fossil fuel consumption, and avoiding greenhouse gas emissions, such as  $SO_2$ ,  $NO_x$ , and  $CO_2$ , and total suspended particles. Economic developments are initiated and improved using the reviewed new developments.

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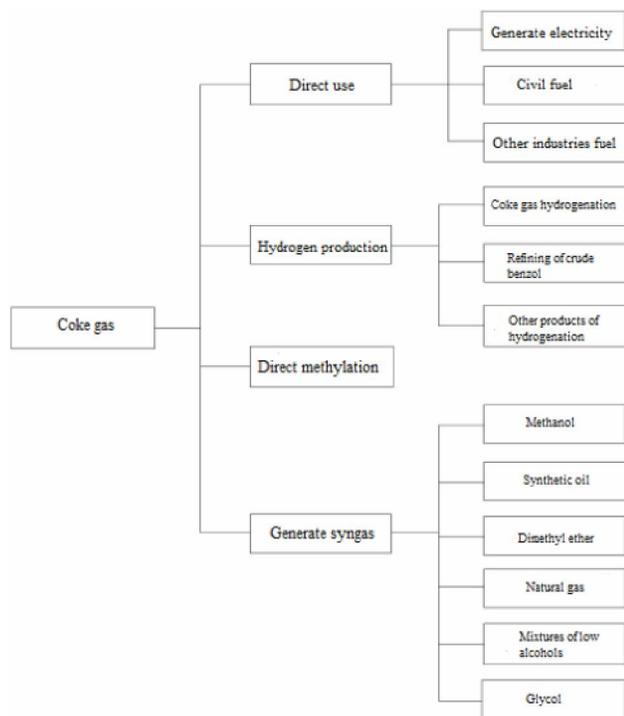
# Communications

value is 17-19 MJ/Nm<sup>3</sup>. Furthermore coke gas is the best gas fuel. It is widely used in different areas, such as civil and industrial use (ceramicsfactory, cementplant and glass factory)<sup>[4]</sup>.

**TABLE 1 : The properties of coke gas**

composition	H <sub>2</sub>	CH <sub>4</sub>	CO	CO <sub>2</sub>	N <sub>2</sub>	O <sub>2</sub>	C <sub>m</sub> H <sub>n</sub>
Content, %	54-60	19-24	5.5-7	2-3	3-5	0.1-0.8	1-3
composition	a	C <sub>6</sub> H <sub>6</sub>	NH <sub>3</sub>	H <sub>2</sub> S	b	HCN	tar
Content mg/m <sup>3</sup>	≤100	≤2000	≤50	≤20	≤50	≤300	≤50

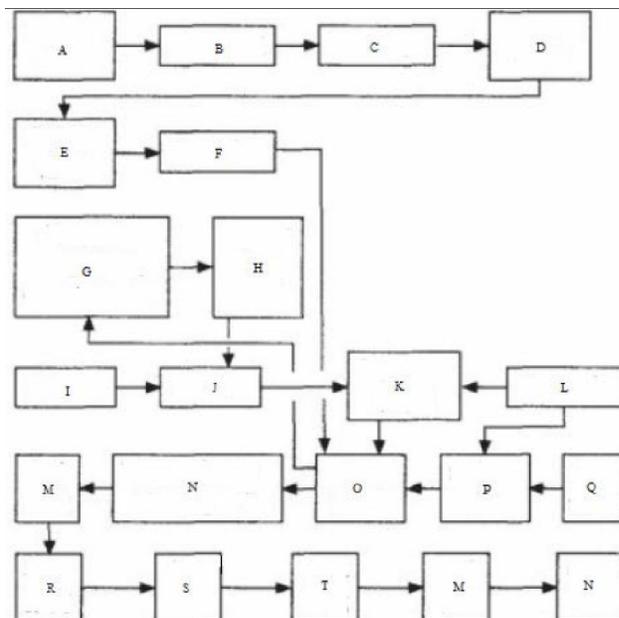
Note: a and b mean naphthalene and organicsulfur, respectively



**Figure 1 : Comprehensive utilization of coke gas**

## The utilization method of coke gas

There are three utilization methods of coke gas listed as follows: using coke gas as feedstock and fuel and



Note: A-coke gas washed; B- coke oil trap; C- get rid of acid; D- coke gas tank; E- coke gas compressed; F- desulfuration with wet process; G- hydrogenation; H- desulfuration with dry process; I- condensation; J- saturation tower; K- steam heat; L- overheating steam; M- residual heat recovery; N- convertor; O- boiler; P- oxygen and steam mixture; Q- oxygen; R- condensation and separation; S- compression; T- generate methanol; M- methanol's rectification; N- methanol's tank.

**Figure 2 : Process of flow of catalytic oxidation of coke gas**

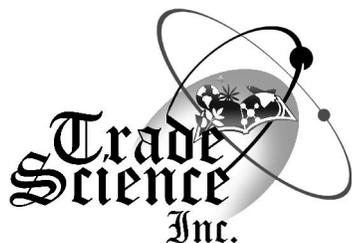
generating electricity, such as coke gas as feedstock produces methanol, ammonia and natural gas; coke gas as fuel generates electricity and residential fuel and hydrogen got from coke gas is widely used in different fields. TABLE 2 presents different utilization methods of coke gas compared<sup>[5]</sup>.

## Coke gas as feedstock produces natural gas<sup>[4]</sup>

Natural gas is one kind of mixture. Its main composites include CH<sub>4</sub>. Furthermore, there is a little bit of C<sub>2</sub>H<sub>6</sub>, C<sub>3</sub>H<sub>8</sub> and C<sub>4</sub>H<sub>10</sub>. Natural gas is widely used in different fields such as public fuel, vehicle fuel and spe-

**TABLE 2 : Different utilization methods of coke gas**

Fields	Advantage	disadvantage
Public fuel	Simple process and low maintenance	High impurity and low heat value
Generate ammonia	Low cost compared with natural gas and coal	Complicated process and high energy consumption
Generate methanol	Low cost compared with natural gas and coal	High requirement for coke gas
Generate electricity	Less investment, less space and simple operation	Less economic benefits
Generate hydrogen	Less investment, low operation fee and simple process	Difficult transportation
Reduced iron	Save coke and less CO <sub>2</sub> discharge	Must build to be near to the steel works
Produce natural gas with the condition of low temperature	High utilization efficiency	Must have stable client



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## Economic benefits of coke gas utilization in China

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### ABSTRACT

This paper introduces the source and utilized circumstance of coke gas in China. The properties of coke gas are also discussed. The utilized circumstance of coke gas is discussed in detail, such as, coke gas as feedstock is produced to liquefied petroleum gas; coke gas is used to methanol. In so doing, the energy demand of China will be better met with least damage to the environment. According to the full utility of coke gas sources, their good economic and social benefits are obtained.

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### KEYWORDS

Economic benefits;  
Coke gas;  
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### INTRODUCTION

With Chinese economic growth, China becomes one of the largest countries produced coke in the world. The output of coke in China arrived at 3.88 billion tons in 2010<sup>[1]</sup>. Coke gas is usually generated during coke production process, such as 1 ton of coke gas produces 430 m<sup>3</sup> of coke gas. Lots of coke gas is directly discharged to atmosphere except using coke gas as fuel for the coking plant, the public and the resident, etc<sup>[2]</sup>.

Nowadays the efficiency of coke gas utilization is very low in China, because most of these resources are fired and discharged into the environment. This latter has a serious negative effect on our health and living, strongly degrades the environment, and causes serious pollution; therefore researchers and engineers turn a lot of effort in the development of this area, focusing on increasing the efficiency of coke gas source utilization with maximum economic benefits.

It is an urgent demand to utilize coke gas sources

in a more rational way as simple fuel, involving new processes, which could result in improving the product's value. These new processes could improve the energy efficiency and decrease the environmental pollution as well. In this paper, two important methods are reviewed, namely the production of liquefied petroleum gas and methanol, based on various coke gas sources.

### RESULTS AND DISCUSSION

#### The properties of coke gas

Coke gas named as coke oven gas is one of the main products which come from high temperature dry distillation of coke. Its properties and yields are different due to using different type of coke and different dry distillation condition. Coke gas is a compound gas, such as hydrogen, methane, CO, unsaturated hydrocarbon (C<sub>2</sub> above), CO<sub>2</sub>, oxygen and nitrogen, etc<sup>[3]</sup>. The properties of coke gas are shown in TABLE 1. Its heat