



Evolution in Development of Daqing Oil Shale in China



**Fang Chaohe, Zheng Dewen, Ge Zhixin
Wang Hongyan Lei Huaiyu Zhang Ruida**

**Research Institute of Petroleum Exploration and Development-
Langfang**

New Energy Department

28th Oil shale Symposium, Oct. 15, 2008



PREFACE

- Nowadays , the development and utilization of oil shale have surged around the world with highly increasing oil price. The former is extracting shale oil by employing new technologies such as developing large scale, environmental and efficient retort, the latter is moving toward multi-utilization such as oil refining , power generating , cement and building material production.
- CNPC, the largest oil company in China ,has been involved in development of oil shale and planned to complete the project of annual production of shale oil reaching 3×10^4 tons in the “11th five-year plan” in Daqing area.

INDEX



Oil shale resource in china

**The current status of shale oil production
in china**

**The development prospect of oil shale
in CNPC**

Conclusions



Oil shale resource in China

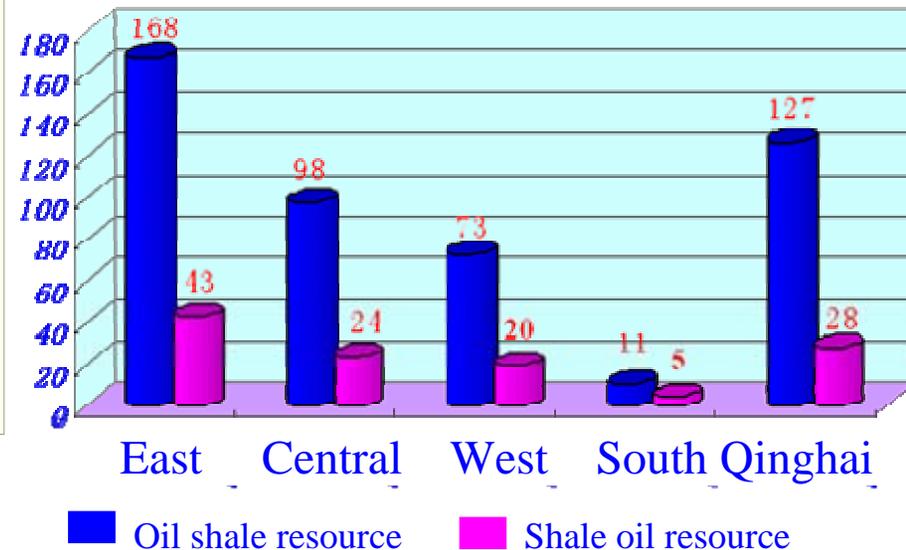
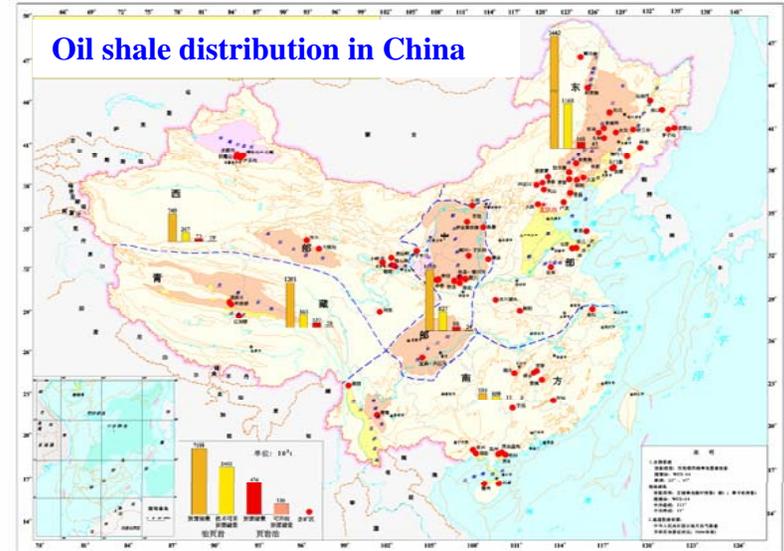
1.1 Oil shale reserves in the world

- Overall shale oil reserves in the world is $411 \times 10^9 \text{t}$
- Uneven distribution:(Dyni , 2002) mainly in America, China, Russia and Brazil etc.
- Overall oil shale reserves in China are $47.6 \times 10^9 \text{t}$ and the recoverable reserves of shale oil are $12.0 \times 10^9 \text{t}$ (LIU Zhaojun,2006)

Nation	reserves of shale oil (10^8t)	Evaluation time
America	3035.66	2003
China	476.0	2006
Russia	387.7	2002
Brazil	117.34	1994
Canada	63.00	1997
Jordan	52.33	1999
Australia	45.31	1999
Estonia	24.94	2000
Italy	14.31	2000
France	10.02	1978

1.2 Oil shale distribution in China

- China is rich in oil shale; there are over 80 oil shale deposits which are located in 22 provinces, 47 basins. (Liu Zhaojun, 2006)
- China's oil shale is mainly distributed in the east part, the central part and Qinghai-Tibet (SongLiao basin, Ordos basin and Jungar basin etc).
- The oil shale resources of the east part are 35 % of the nation's total.



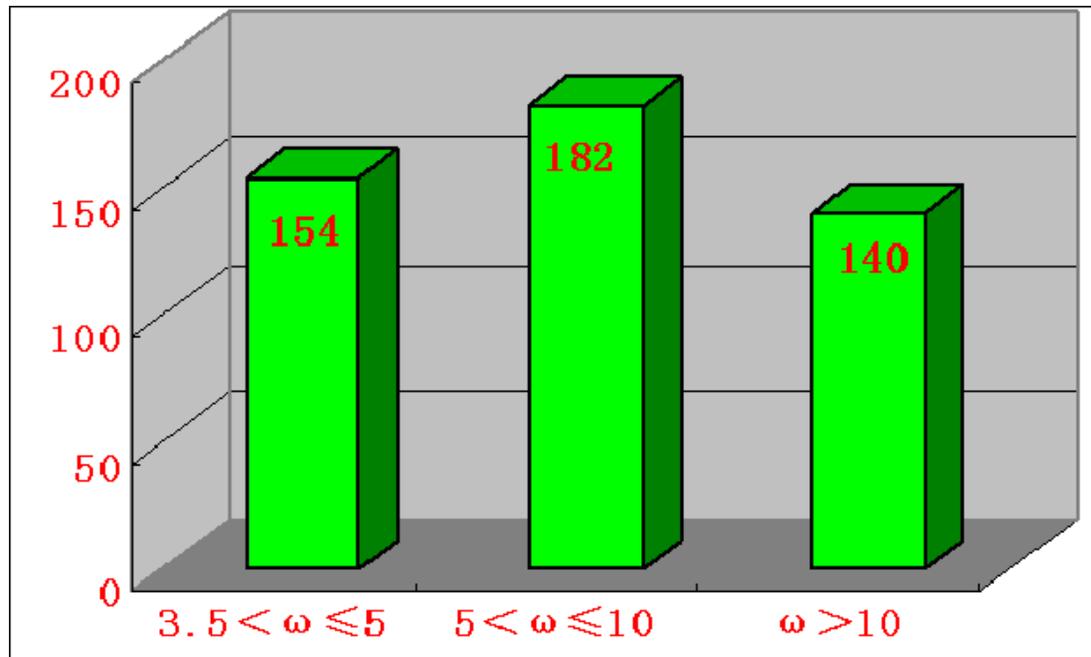


Oil shale resource in China

1.4 The distribution of oil content

- ◆ 18.2×10^9 t of shale oil with an oil content of 5%-10%, about 35% of total, and 14×10^9 t with an oil content of more than 10%, and about 29% of the total.

•Oil resource



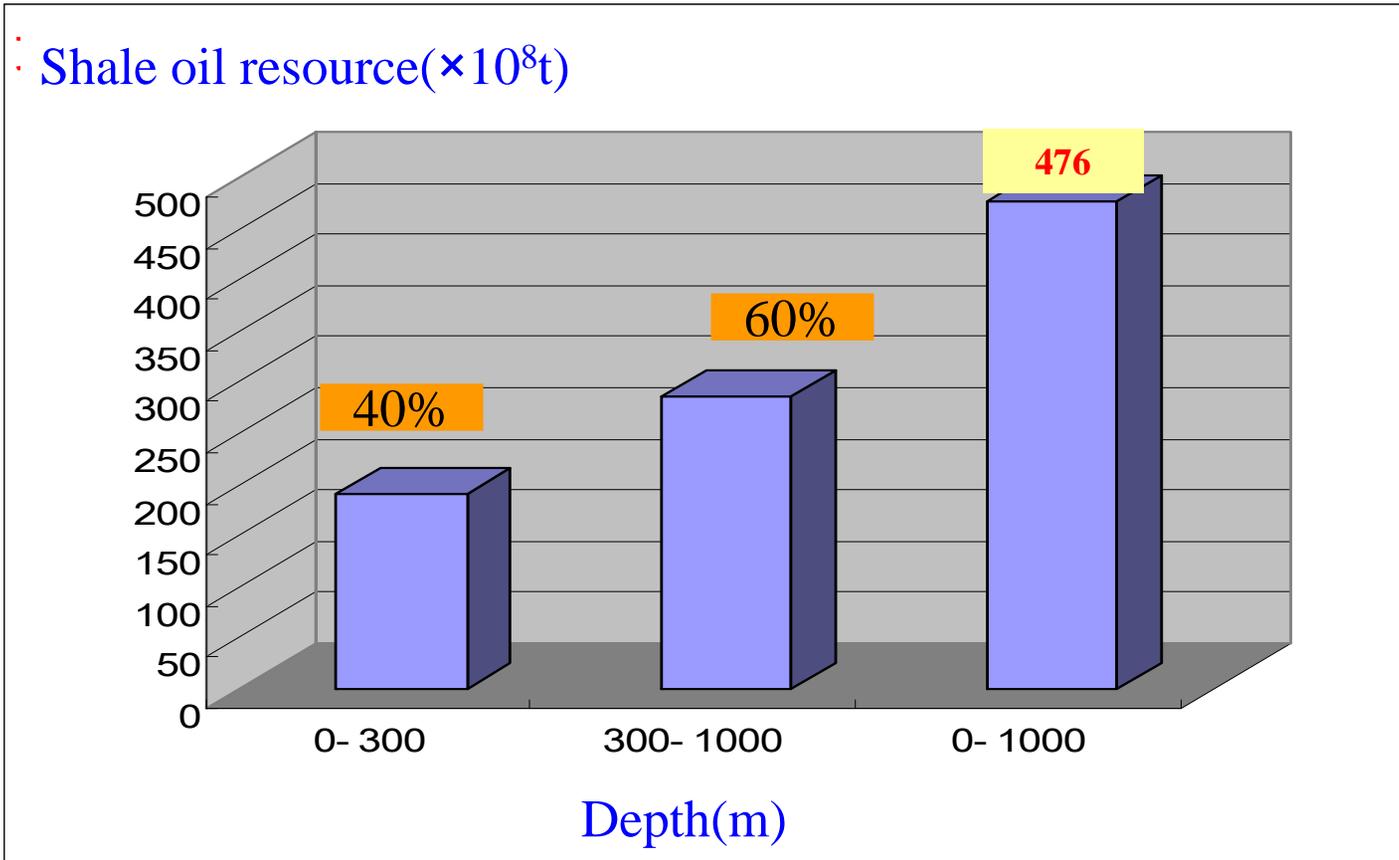
•Oil content(%)



Oil shale resource in China

1.5 Burial depth of oil shale

- ◆ shale oil within the burial depth of 300-1000 meters is about 60% of the total , which presents great challenges for the middle and deep parts development.



INDEX

Oil shale resource in china



**The current status of shale oil production
in china**

**The development prospect of oil shale
in CNPC**

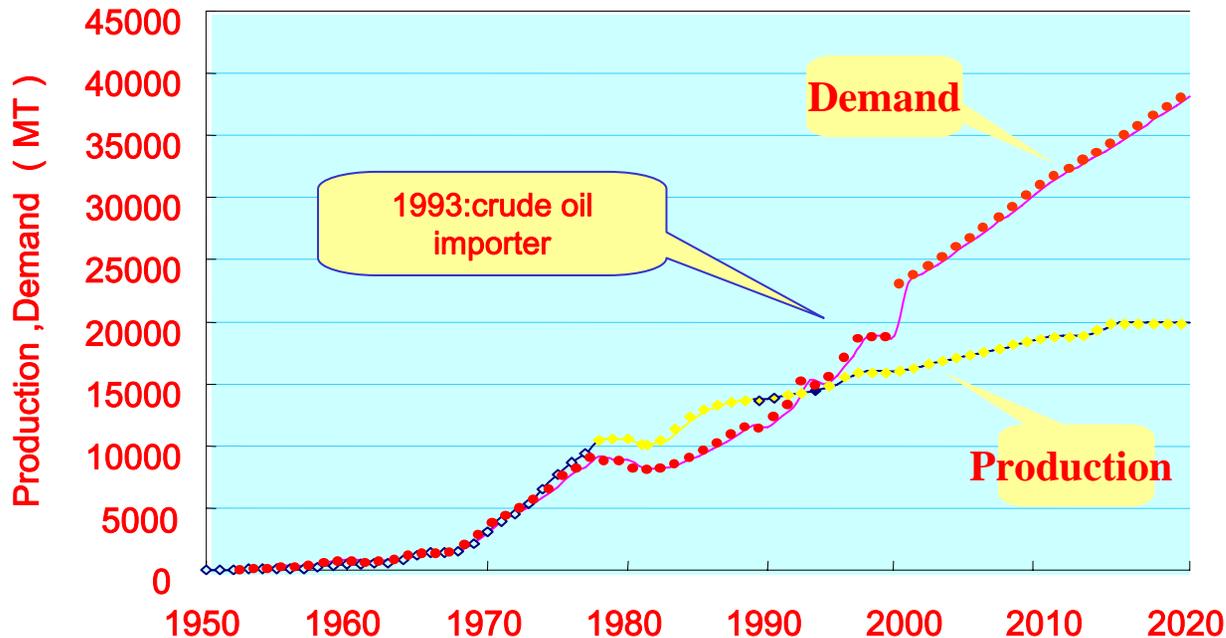
Conculsions



The current status of shale oil production in china

2.1 Comparative analysis of oil production and consumption in China

- From 1993, becoming the crude oil importer
- In 2007, imported crude oil is $163 \times 10^6 \text{t}$ and Oil product is $37.4 \times 10^6 \text{t}$, aggregate quantity is $2000 \times 10^6 \text{t}$, whereas the domestic crude oil production is $187 \times 10^6 \text{t}$, which causes our country's ratio of depending on for existence goes up to 51%.



Based on the data Of IEA :

2007: the world daily requirement is $85.7 \times 10^6 \text{t bpd}$, whereas the daily production is $84.86 \times 10^6 \text{t bpd}$.

2008: daily requirement is $87.8 \times 10^6 \text{t bpd}$, daily production $87.39 \times 10^6 \text{t bpd}$.

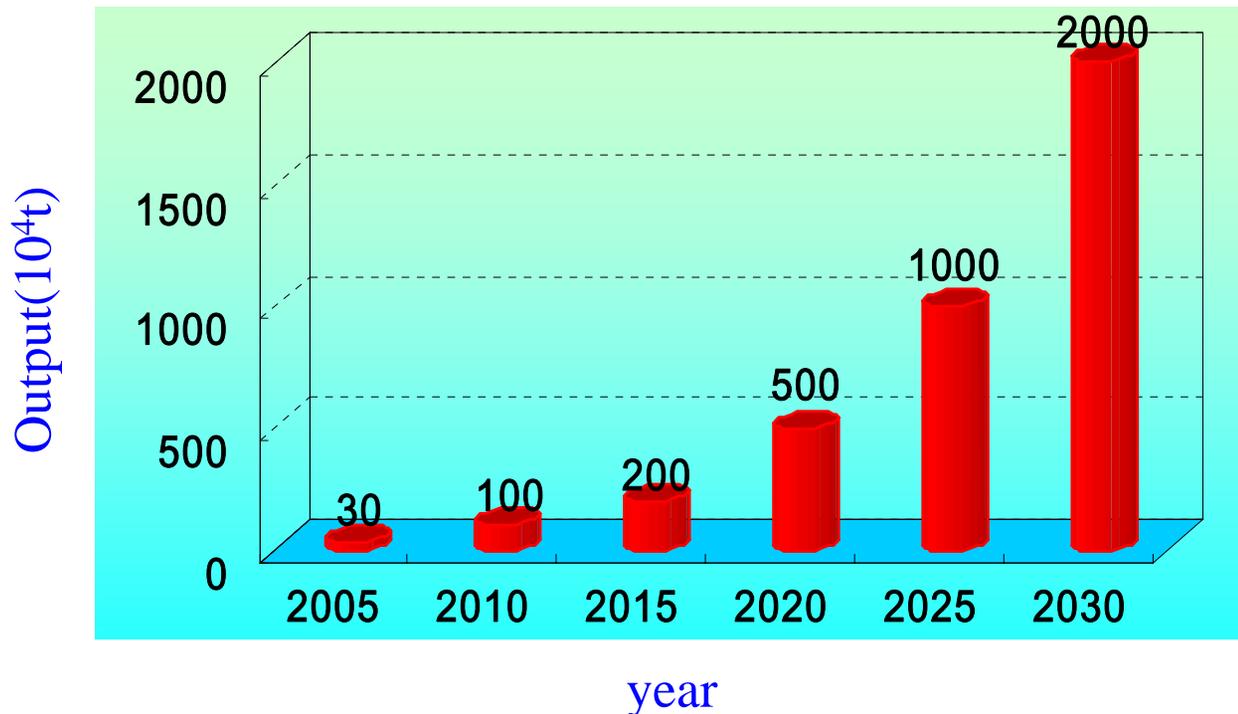
The graph between crude oil production and demand



The current status of shale oil production in China

2.2 The production output and development trend of shale oil

- The output in 2007 is $380 \times 10^3\text{t}$.
- It is estimated that the output in 2010 will be $1 \times 10^6\text{t}$.
- It is estimated that the output in 2020 will amount to $5 \times 10^6\text{t}$.





INDEX

Oil shale resource in china

**The current status of shale oil production
in china**



**The prospect for development and use
of oil shale in CNCP**

Conculsions



The prospect for development and use of oil shale in CNPC

3.2 Oil shale in Liushuhe basin

3.2.1 The main introduction to Liushuhe shale oil

- ❑ The oil shale in Liushuhe basin is 55.9×10^6 t , oil reserves exceeds 5.5×10^6 t.
- ❑ Due to the great thickness , shallow burial depth and high oil content, it is becoming the most preferable development and utilization area

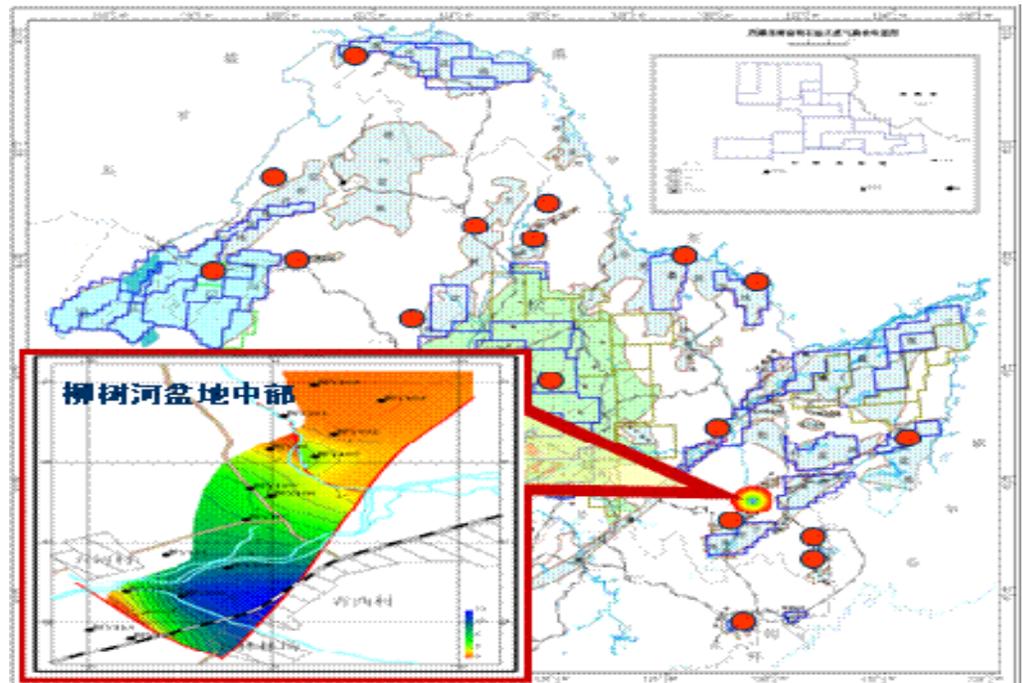
Location:the southern part in Daqing area, total area 1400 km²。

Oil content:3.7-17.2%

Depth :10-134m

Thickness :2-15m

The total reserves in Liushuhe Y109 well is amount to 17.4×10^6 t and the shale oil 2.6×10^6 t, the potential of expanding reserves is high in the CNPC mining area .

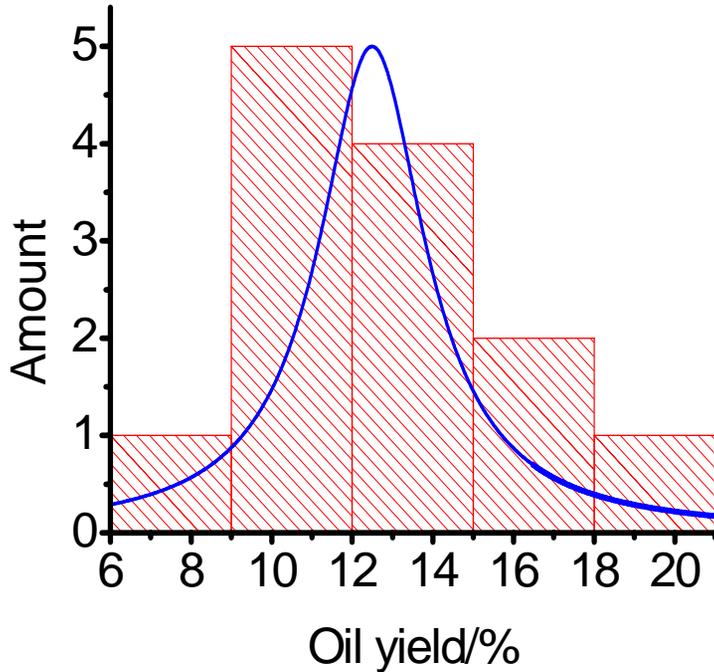




The prospect for development and use of oil shale in CNPC

3.2 Oil shale in Liushuhe basin

3.2.3 Oil yield



Oil content (%)

Surface water	: 8.51~33.35 %	22.5 %
Pyrolysed water	: 2.71%~13.4 %	9.27 %
Semi-coke	: 36.1 % ~ 80.94 %	49.7 %
Pyrogenous steam	: 1.11 % ~ 21.43%	9.42 %
Heat value	: 2650 ~ 7962 kcal/kg	5809 kcal/kg

Experimental data analysis indicated: Liushuhe oil shale with the characters of three “highs”:

- ✓ High oil yield: 6-14 %
- ✓ High pyrogenous steam: average 9.42 %
- ✓ High heat value: average 5809 kcal/kg

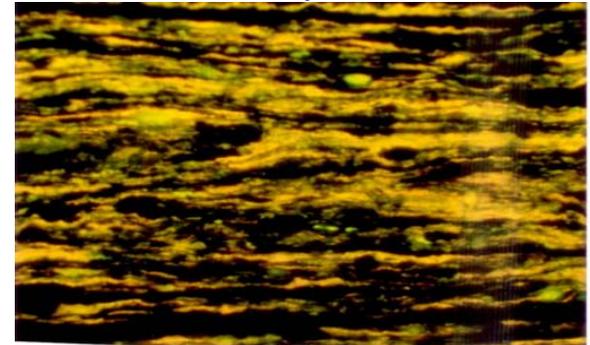
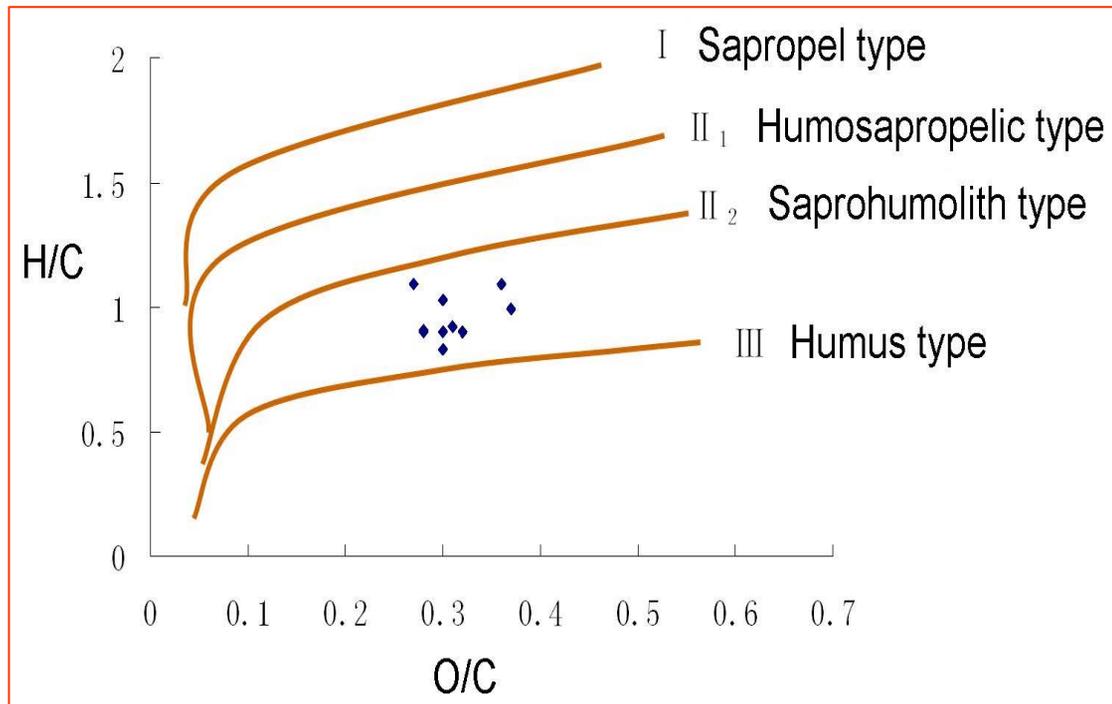


The prospect for development and use of oil shale in CNPC

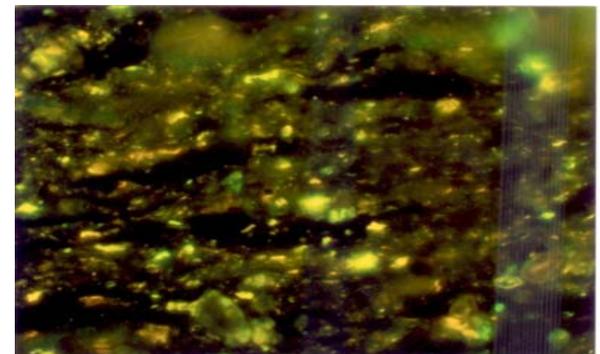
3.2 Oil shale in liushuhe basin

3.2.2 The character of oil shale

After laboratory analysis , the organic kerogen type of Daqing oil shale is saprohumolith type, Which has the high oil and gas production ability.



II₂



III

3.2 Oil shale in Liushuhe basin

3.2.4 Thermal Stability Analysis

- Small intensity and fragile, especially after retorting.
- Gas heat carrier method is unsuitable



Sample number	Depth (m)	Size (mm)	Pressure (kN)	Uniaxial compressive strength P (kpa)
Liu Y108 #	71.9	58.3	3.6	1348.58
Liu Y105 #	71.5	60.15	1.5	527.87
Liu Y109 #	80	63.97	1.5	466.71
Liushuhe124#	86.85-87.6	Φ102×115	54.4	6660
Liushuhe122#	37.15-38.15	Φ95×110	0.5	70
Fushun shale				7800



The prospect for development and use of oil shale in CNPC

3.3 Retorting process research

3.3.1 Choosing retort process

Due to the low thermal resistance ,small intensity ,only fine particle solid heat carrier method can be adapted. After several meeting, the Chinese and Russian experts approved and CNPC has accepted the plan.





The prospect for development and use of oil shale in CNPC

3.3 Retorting process research

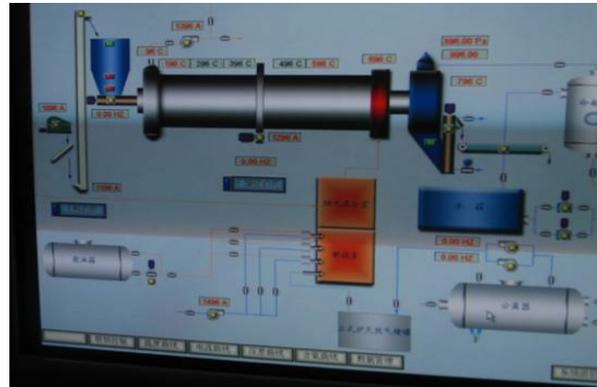
3.3.2 The evolution of retorting technologies

- CNPC has launched the development retorting and designed the facilities with daily processing ability of 24 t. Furthermore , the field experiment has been done and achieved good results.
- In 2005, it has been used in the retorting of dry oil sand , in 2007 in oil shale and oil sludge.

Planar rotation gas retort



Computer control system



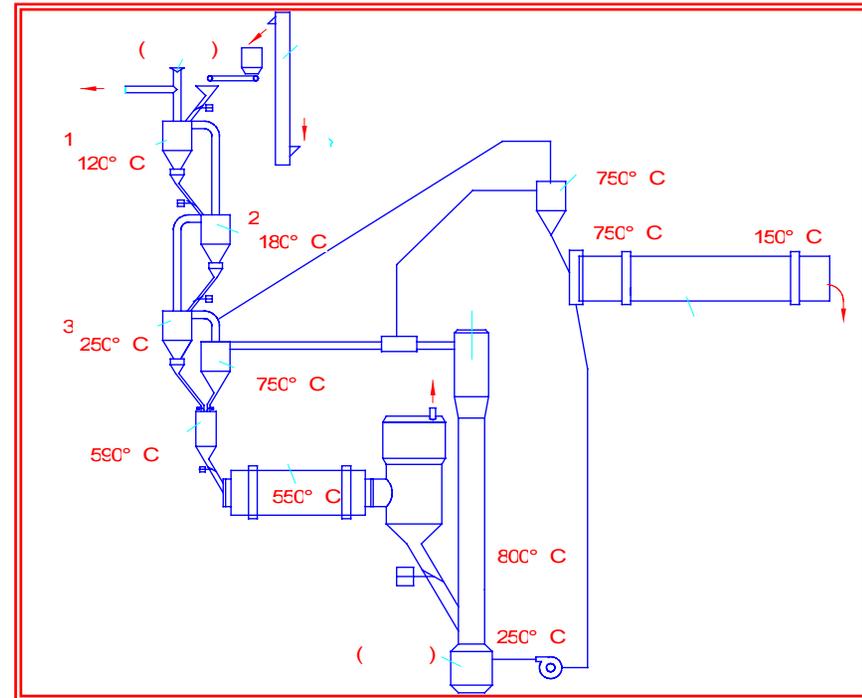
Shale oil



3.3 retorting process research

3.3.3 The evolution of retorting technologies

- From 2006, CNPC starts to research and develop new type retorting methods to process the oil shale with diameter smaller than 30mm
- At present, the facilities with the daily processing ability of 1×10^6 t have been developed.





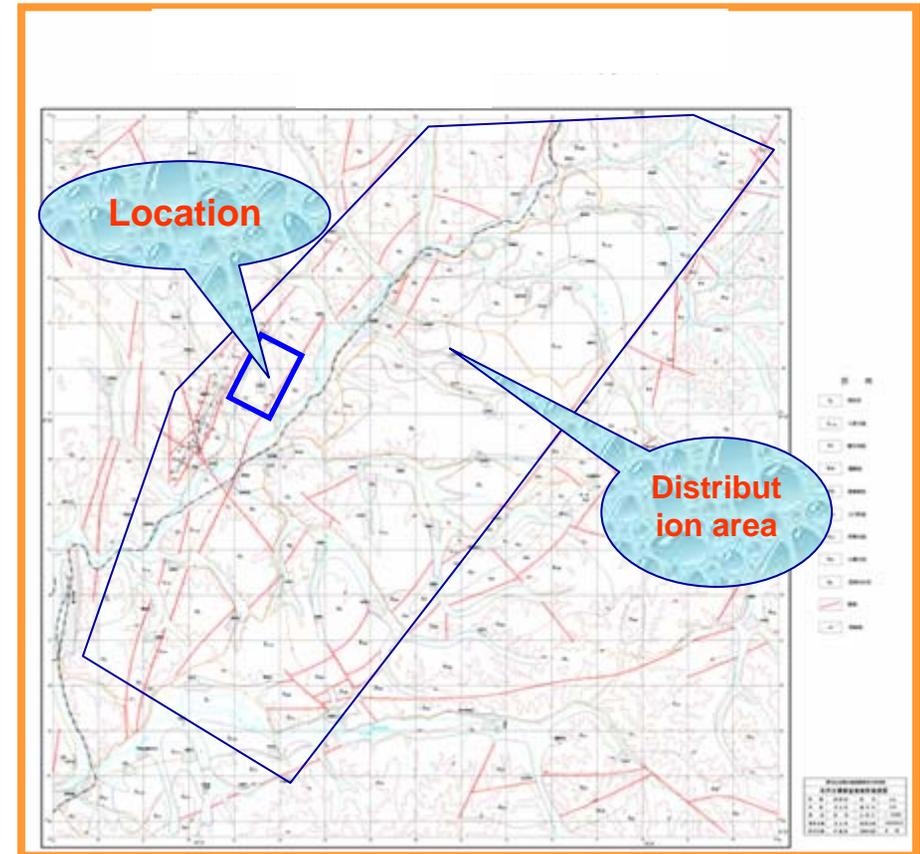
The prospect for development and use of oil shale in CNPC

3.4 Field trial

3.4.1 Processing scale

After finishing the above-mentioned work, CNPC decided to build a base of 30×10^3 t shale oil capacity and had a ceremony on Aug. 12, 2008 in Mudanjiang

- Annual processing ability: 600×10^3 t
- Annual oil-production: 30×10^3 t



3.4 Field trial

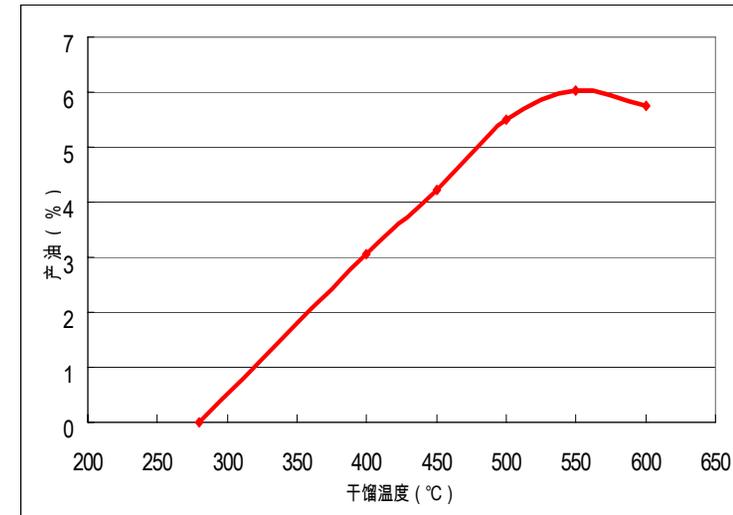
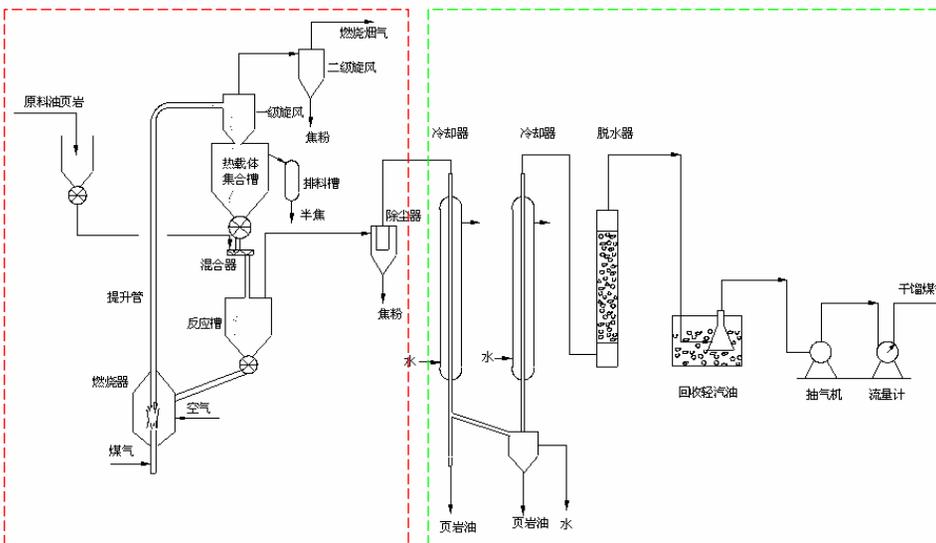
3.4.2 Introduction of process

Processing material is fine particles with diameter less than 30 mm

The best retorting temperature is 520 °C

Recovery ratio of shale oil amounts to 90%

15 tons oil shale can be extracted to produce 1 ton of oil





INDEX

Oil shale resource in china

**The current status of shale oil production
in china**

**The prospect for development and use
of oil shale CNPC**



Conclusions



Conclusions

- ◆ Because the oil shale of Liushuhe basin in Daqing has the following characters: abundant resources ,stable distribution , shallow burial depth , high thickness , it is one of the most preferable developments area.
- ◆ The organic kerogen type is saprohumolith type, which has high oil and gas production ability.
- ◆ “Three highs and one low” characters of oil shale in Liushuhe basin (high oil yield, high pyrogenous steam, high heat value and low intensity) makes the Fushun retorting method unsuitable.
- ◆ Fine particle retorting method has the following advantages: high oil-discharging speed, high oil yield, high utilization of raw materials and low environmental impact. Fine solid particle heat carrier method can be used.
- ◆ CNPC- the largest oil company in China , through its involvement will promote oil shale development and utilization in to a golden stage of fast development in China.