UNDERGROUND COAL GASSIFICATION

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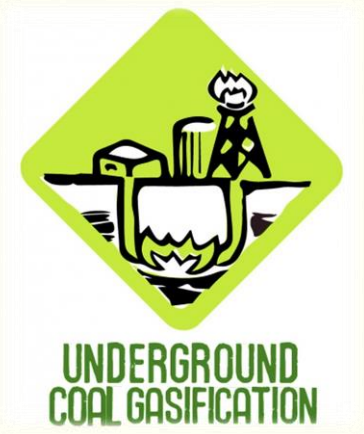


Introduction

- Underground coal gasification (UCG) is an industrial process, which enables coal to be converted into product gas.
- UCG is an in-situ gasification process carried out in non mined coal seams using injection of oxidants, and bringing the product gas to surface through production wells drilled from the surface.
- It is a complex process involving
    - Chemical reaction
    - Heat and mass transfer
    - Complex flow dynamics
    - Growing cavity dimensions

Why UCG?

- Energy market scenario.
- High and ever increasing fuel prices.
- A rising energy consumption in the developing world.
- Growing shortage of supply of oil and natural gas.
- Depletion of several major natural gas field across the world.

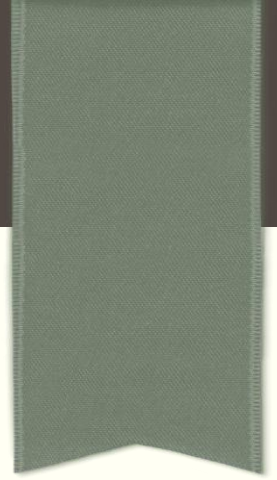
Site Selection for UCG

- **Characteristics of the coal seam** i.e. permeability, fault structure of local strata ,geology and hydrogeology of area which surrounds target coal seam should be known.
- **Drilling of pilot bore hole** to coal seam depth for coring and seam characterization.
- **Seismic survey/3D** of whole area.
- **Modelling of hydrogeology** to meet the ground water requirement.

Criteria for UCG

UGC requires special criteria for coal seam:

- The coal seam lie underground at a depth of 30 -800 meter.
- .The seam thickness is more than 5 meter.
- The ash content of coal is less than 60%.
- High volatility, low grade and non-caking coal is preferred.
- The seam has minimal discontinuities and no aquifers nearby.



UCG Process

1.Well construction and linkage

- Two types of wells: the injection well and the production well .
- Both of the wells are drilled into the coal. The first of them is for the injection of the oxidants and the other one brings the gas produced to the surface.
- Linking the injection and production wells allows to control the development of the cavity and the syngas production.
- Methods of linking: Directional Drilling, Induced Hydraulic fracturing.

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2.Ignition

- After the wells are constructed, the coal seam is partially dried. This can be done by blowing air through the injection well .
- Method of ignition: Use an ignition well and drop down a torch to set fire to the coal.
- There are different method of ignition depend on the geology, depth and many other factor.

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3.Gasification and gas production

The process divided into three different zones.

- Combustion zone(exothermic reaction)
  - It generates heat and gases, which can be used in later gasification reactions.
  - The combustion reactions are:

    $C + O_2 \rightarrow CO_2$ + heat (complete combustion)

    $C + \frac{1}{2}O_2 \rightarrow CO$ + heat (partial combustion)

    $CO + \frac{1}{2}O_2 \rightarrow CO_2$ + heat

- Gasification(endothermic reaction)
  - In combustion all oxygen is used during combustion reaction.
  - Gasification reaction takes place using the heat from combustion reaction:

    $C + H_2O$ + heat $\rightarrow H_2 + CO$

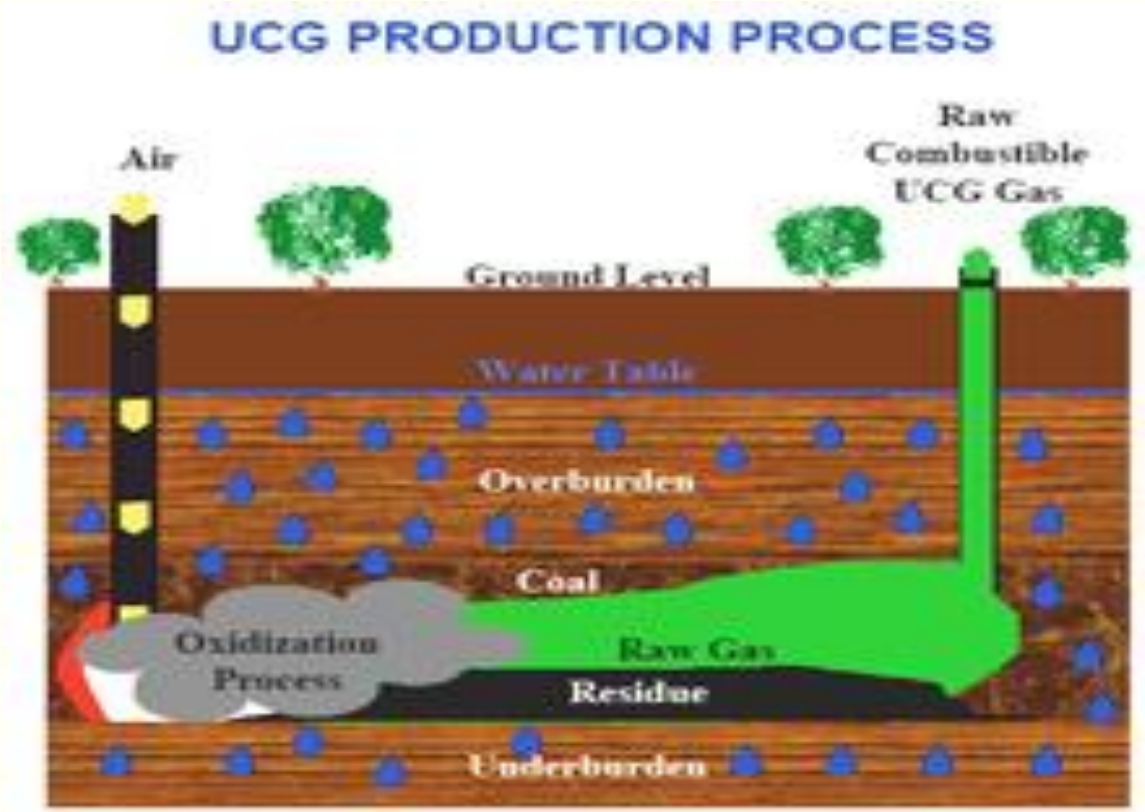
    $C + CO_2$ + heat $\rightarrow 2CO$

    At equilibrium,

    $CO + H_2O \rightarrow H_2 + CO_2$ (water-gas-shift reaction)

- Pyrolysis
  - After the coal has lost its moisture, it undergoes pyrolysis. This happens at temperatures close to 400°C.
  - Coal $\rightarrow CH_4 + H_2O$ + Hydrocarbons + Tars + Volatile gases .

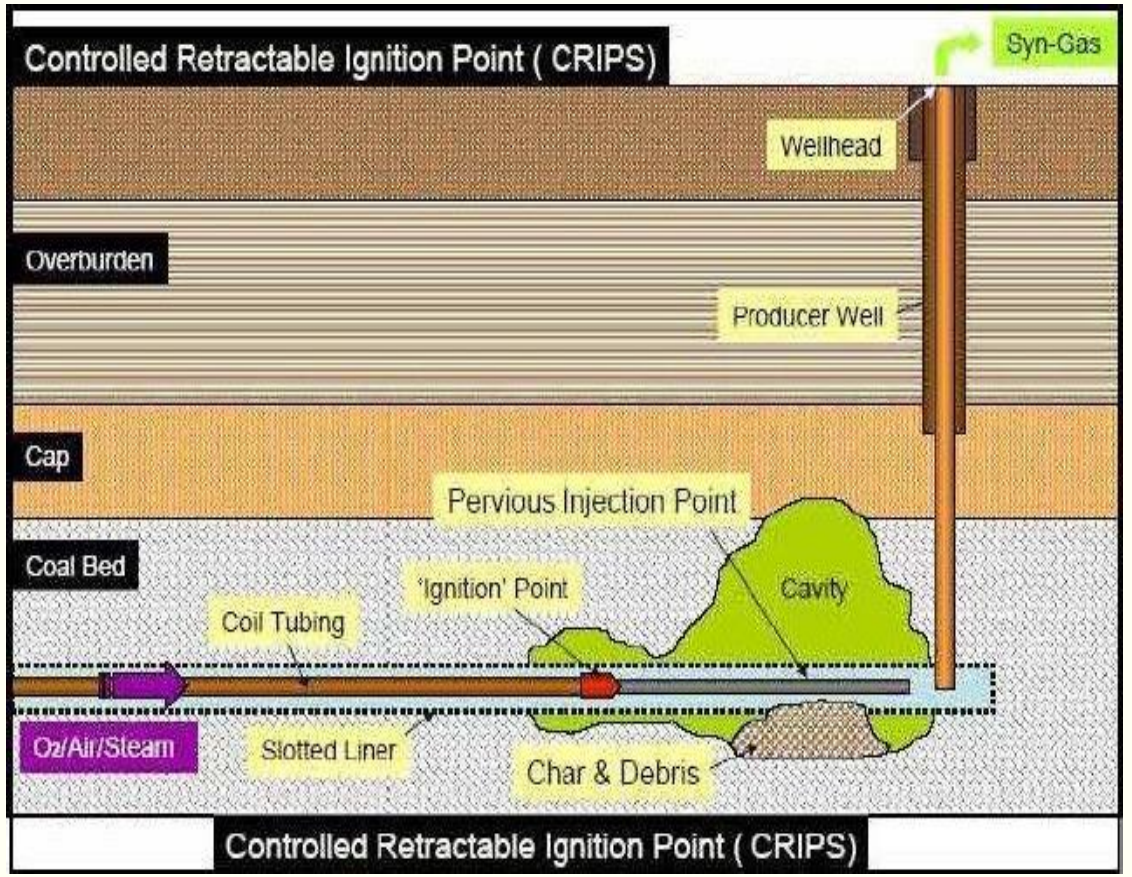
Simple diagram of UCG

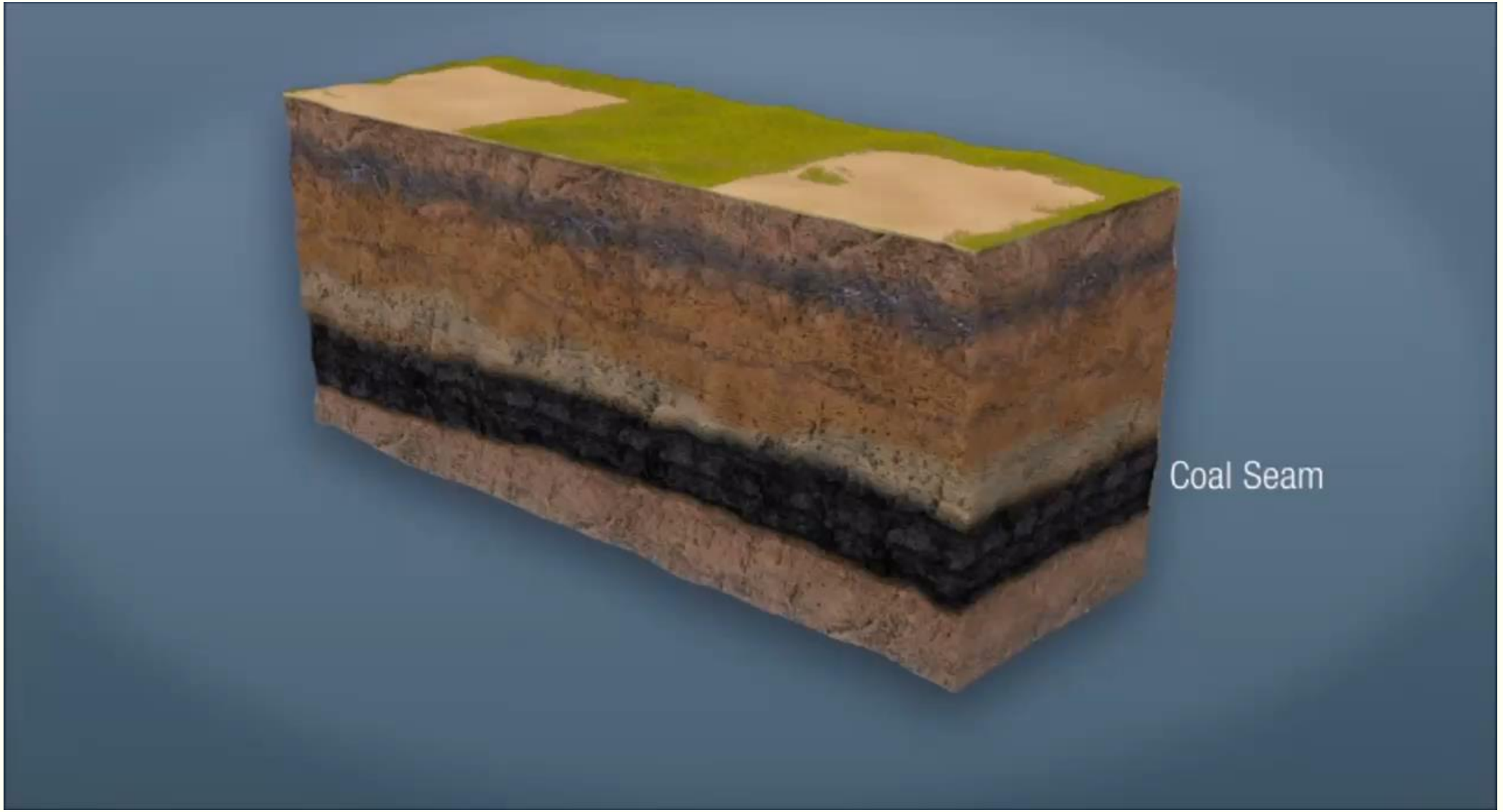


Recent Development in UCG

Controlled Retractable Ignition Point (CRIPS)

- This technique developed in the USA, involves the use of a burner attached to coiled tubing. The device is used to burn through the borehole casing and ignite the coal.
- Injection point on the bottom of the coal seam and to move it backwards away from the collapse zone into fresh, solid coal.
- The principle of controlled retraction allows the operator to choose the optimum time and distance to move the injection point.




Coal Seam

Benefits

- Environmental benefits.
  - Does not require an external water source to operate.
  - Lower emission.
  - Low dust, noise and visual impact.
  - Reduce methane emission.
  - No dirt handling and disposal.
- Financial benefits.
  - Low capital cost.
  - Reduce cost of plant installation.
  - Reduce transportation cost.
  - Lowers cost of environmental clean up.
- Social benefits.
  - Reduce risk of life.
  - Local communities no longer face air pollution

Demerits

- Drinking water pollutants.
- Cause Noise.
- Subsidence.
- Contamination of ground water.
- Atmospheric emission.

UCG Projects in the world

- In the last few years there has been significant renewed interest in UCG as the technology has moved forward considerably.
- China has about 30 projects in different phases of preparation that use underground coal gasification.
- India plans to use underground gasification to access an estimated 350 billion tonnes of coal. Many industries like Jindal Power, GAIL, ONGC , Reliance etc. plans to set up UCG Project in different part of India.
- South African companies Sasol and Eskom both have UCG pilot facilities that have been operating for some time, giving valuable information and data.
- Demonstration projects and studied are also currently under way in a number of countries, including the USA, Western and Eastern Europe, Japan, Indonesia, Vietnam, India, Australia and China.

Conclusion

Today, high prices of oil and gas and uncertainties about political stability in most of oil producing countries, have renewed interest in all kinds of fuel. A renewed interest in coal gasification is therefore not surprising. Further-more, hydrogen is now a welcome by- product because of the current interest in alternatively fuelled vehicles. UCG is potentially the most important clean coal technology of the future with worldwide application. Ultimately, it could be a substitute for deep mining coal for power generation use. Applying improved UCG technology to gasify deep, thin, and low grade coal seams could vastly increase the amount of exploitable reserves. The coal could be converted togas for a variety of uses and emissions of sulphur, nitrous oxides and mercury could be dramatically reduced. UCG could increase recoverable coal reserves by as much as 300to 400 percent.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SAVE THE
world