Control of firedamp emission

- There is a need to extract seams having greater methane content at greater depths.
- The use of intensively worked high-production extraction methods, such as longwall mining in more gassy mines have led to methane problems in mines even when the emission rates are not excessively high.
- Drainage techniques are applicable in mines where it is not possible to control the methane concentration by general ventilation.
- Theses techniques enhance mine safety by extracting as much methane as possible from the strata before it mixes with the air in the coal faces and roadways and also to increase the production rate.
- No single technique can be universally applied to all the mines since the rate of emission in a seam depends on:
  - ✓Rank of coal,
  - ✓Pressure of gas,
  - ✓Permeability of coal seam,
  - ✓Presence of other seams and sequence of their extraction,
  - ✓Severity of faulting and folding,
  - ✓Relaxation of the strata resulting from coal extraction
  - ✓Extraction method.

- Before adopting the method, investigations should be carried out to predict the anticipated emission rates and movement of methane from seams in the roof and floor through the geologic studies.
- Studies should also be carried on the physical properties of the coal seam being mined now and of those likely to be mined out in the future.
- Collection and analysis of gas emission data from new and existing coal mines has to be done so that an effective system for methane control and ventilation may be designed.

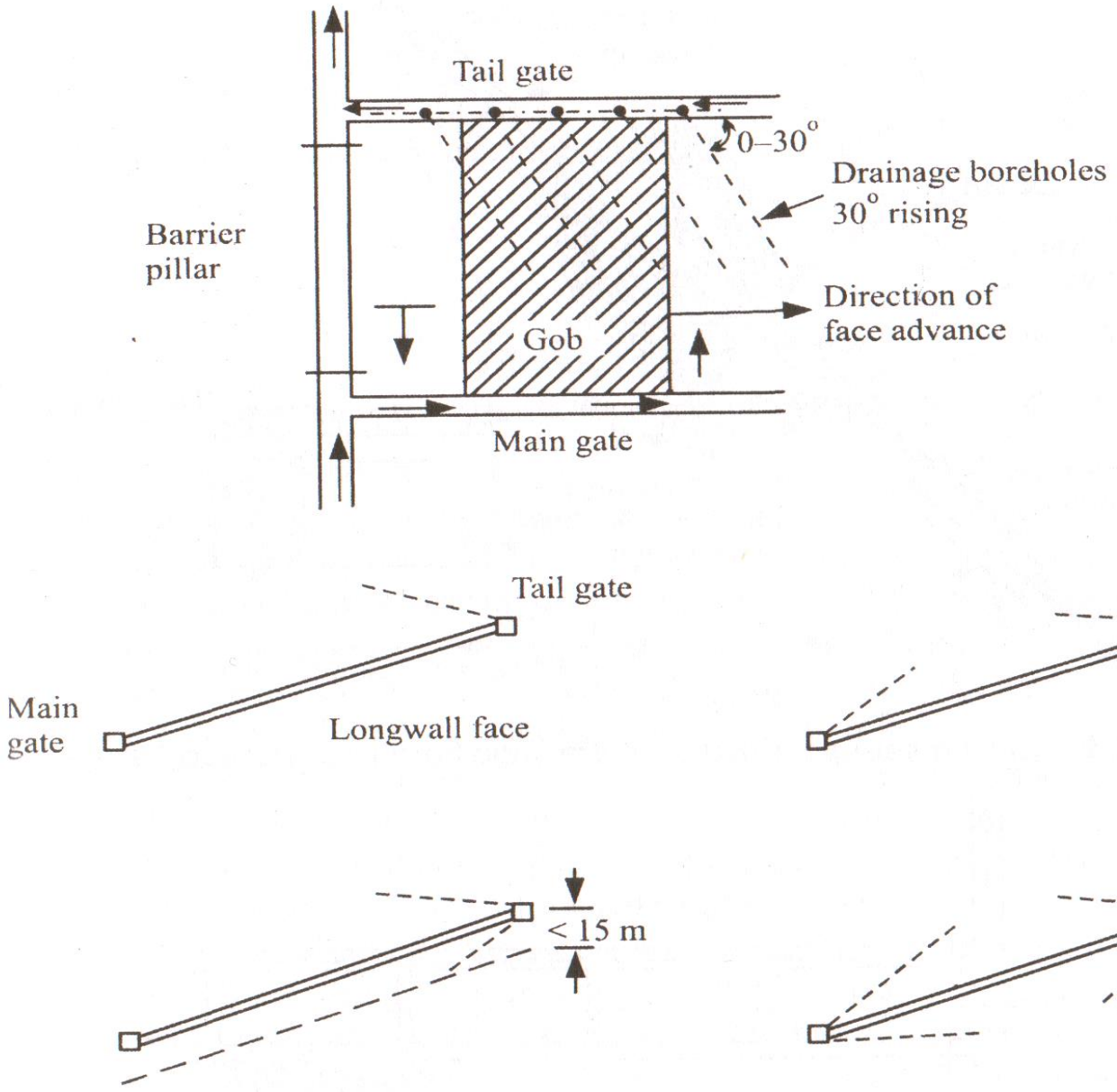
Methane drainage techniques

Underground techniques **Surface techniques**

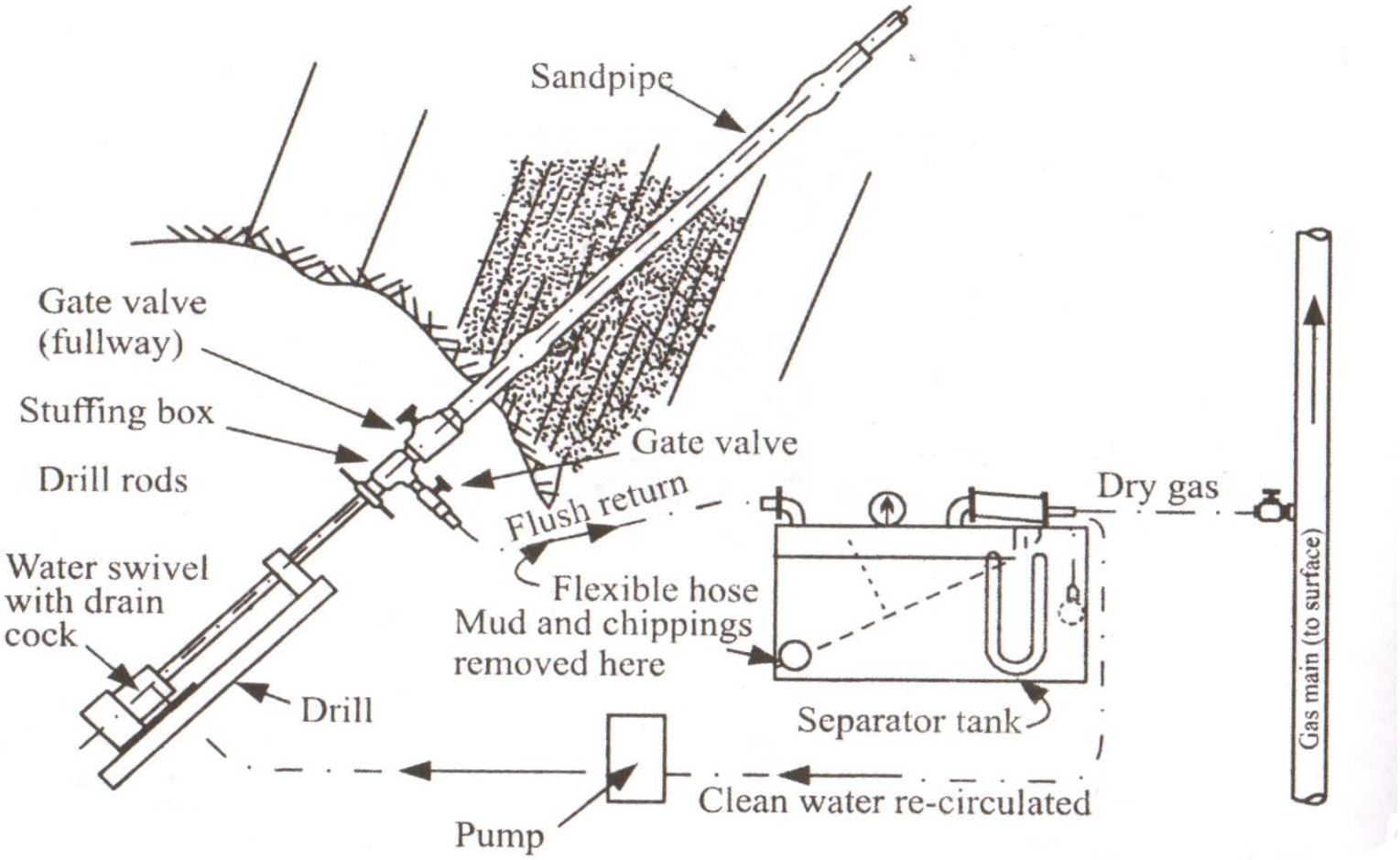
- ***Underground techniques***

1. Cross-measure boreholes

- most common method on European longwall faces.
- Cross-measure boreholes are drilled from the gate roads of advancing longwall faces into the adjacent strata above and/or below the seam being worked over the waste area and close to the working face, usually using special underground rotary drills.



- Methane is drained by applying suction pressure to the hole, and the methane-air mixture is drawn into a pipeline which may be extended to the surface.
- The diameter of the boreholes varies between ***65 and 120 mm***.
- The spacing of the boreholes is important as too wide spacing will allow a significant proportion of gas to escape into the mine workings, while too close a spacing will involve unnecessary and expensive drilling.
- The usual distance between the holes is ***10 to 30 m*** when the zones of influence of the individual holes just meet.
- The optimum spacing is determined by a certain amount of trial-and-error drilling.
- With a properly designed borehole pattern ***50-80%*** of the total methane emission can be captured.
- The boreholes are drilled at angles varying from ***30° to 60°*** to the bedding plane.
- The length of holes may vary between ***25 to 40 m*** exceptionally reaching 150 m.
- Holes are drilled at right-angles to the line of the gate roads have been found from experience to be more successful than holes angled towards the face.



Drilling set-up for methane drainage boreholes

The drainage of gas is normally carried out through boreholes from the return gate or tail gate but drainage from the main gate is also sometimes practiced when gassy and very gassy seams occur in the floor of and close to the seam being worked to prevent methane from entering the air stream in the vicinity of electrical apparatus.

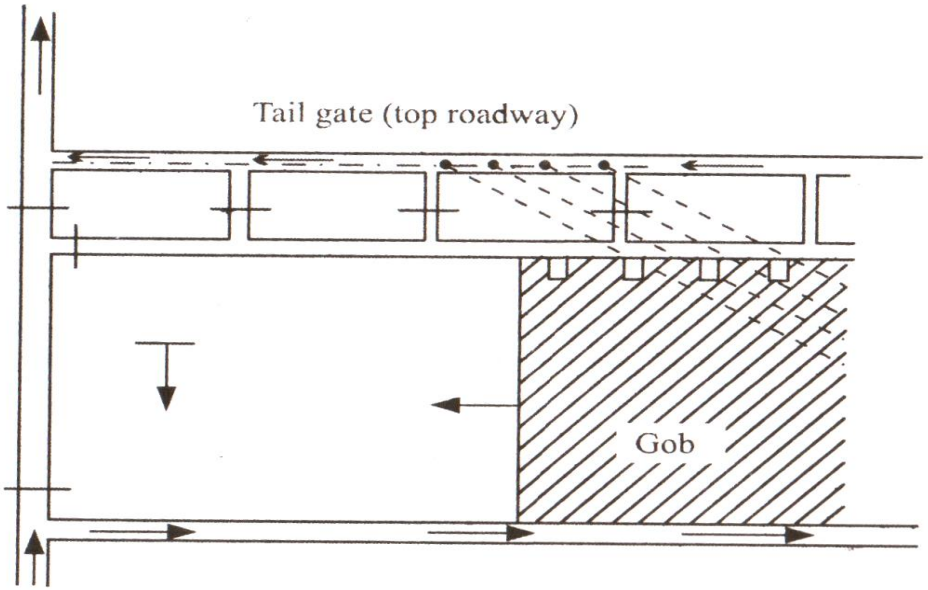
Drainage of floor strata will permit extraction of a lower seam by retreating longwall.

- ***As a rule, boreholes at a distance of 10 to 20 m behind the face yield gas.***
- ***The yield reaching a maximum from a borehole at a distance of about 40 to 75 m from the face.***
- ***The yield of gas from a borehole stops at a distance of 100 m behind the face.***

  Drainage boreholes drilled in the floor of a seam are not as productive as those in the roof due to decreased relaxation and fracture of the floor strata, the relatively short life, and the adverse effect of water of the strata on gas drainage on account of inflow of water into the holes. A larger number of holes in different directions and inclinations will be required. However, drilling of drainage boreholes in the floor is frequently necessary to drain off excessive gas pressures caused by strata movement and to control floor outbursts. The holes are spaced at wider intervals, 40 to 80 m apart and are drilled downwards sub-horizontal to 60° under the waste area.

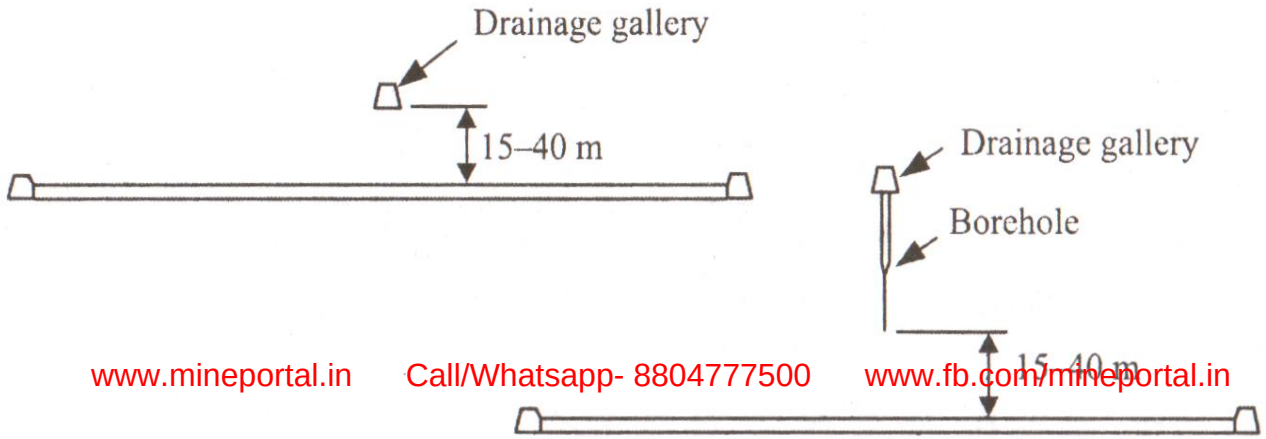
If an overlying seam causes excessively high methane levels in a mine, the overlying seam can be drained of gas by means of boreholes drilled from the return gate in the lower seam.

With retreat longwall mining, the drainage of strata above and/or below the seam being worked cannot be practiced since the boreholes cease to function because of area collapse as the face advances past them. With two tail gates (double entry), however, methane entering the mine opening can be controlled.



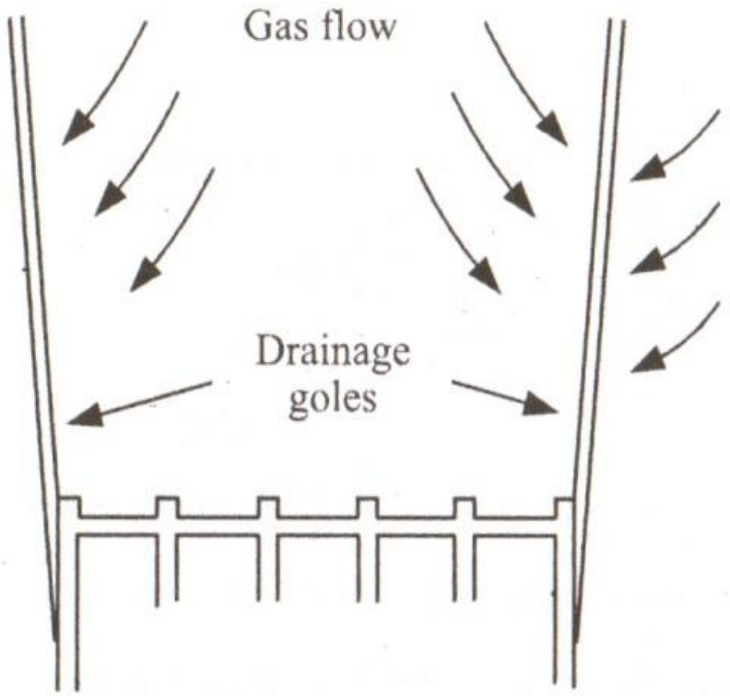
2. Superjacent headings (Hirschbach method)

- method used in highly gassy mines.
- A heading or roadway is driven in the general strike direction in the strata 20 to 30m above the coal seam and over the panel to be mined.
- The roadway is sealed by stoppings to form a chamber and methane is drained from the induced fracture system due to extraction and drawn off through the seal using vacuum pressures of up to 3 m WG.
- If the nature of the strata allows, boreholes may be drilled in the floor.
- In order to reduce costs, old roadways in previously worked-out seams can be used for this purpose.
- With retreating longwall mining, drainage by use of superjacent headings is the best method especially in very gassy seams and seams liable to spontaneous heating.
- The method has a further advantage that there is clear separation between the drainage and production operations.



3. Horizontal boreholes in advance of working sections

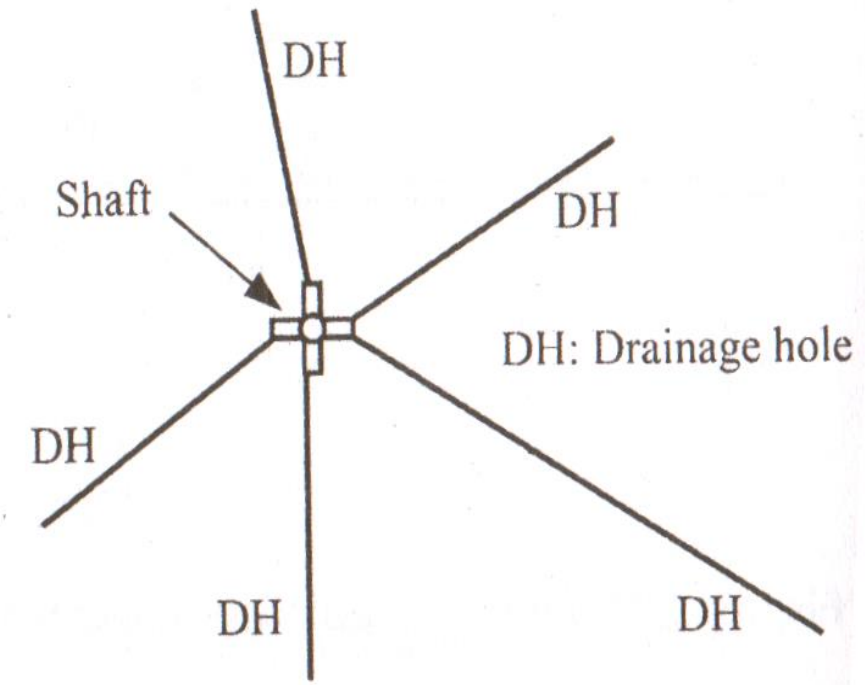
- technique is well suited for adoption in deep mines and mines with an inaccessible topography.
- (+) drilling programme can be incorporated into the mine development plan.



- holes are drilled into a seam in advance of a panel or section.
- (+) can effectively lower methane emissions levels at the working faces by diverting some of the methane in the coal to the holes.
- The rate at which the gas can be removed from the section depends on the length of the drainage holes.
- Generally, the length of the drainage holes should be at least equal to the width of the section.
- After the section is advanced halfway along the drainage holes, the hole drilling phase is repeated.
- Horizontal drainage holes may also be drilled on both sides of single coal or stone headings in highly gassy seams during their fast drivage by the use of machines to reduce gas emission into them.

4. Horizontal boreholes from shafts

- technique has been successfully applied in some mines in the USA.
- The successful application of this technique of de-gassification, however, depends on the insitu permeability of the coal seam and the hole direction relative to the cleat.



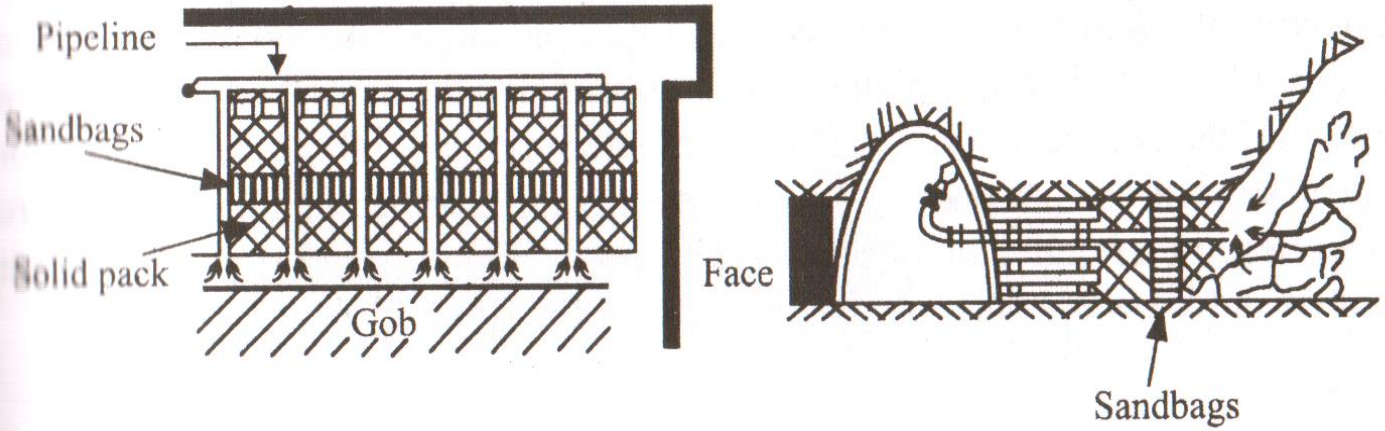
- The large quantities of methane can be drained through long horizontal boreholes drilled on a radial pattern into a virgin coal seam from the bottom of an air shaft long before the shaft is needed for ventilation.
- The advance drainage decreases the gas pressure within the seam over a large area around the shaft and reduces the methane load in the ventilating air.

5. **Water infusion**

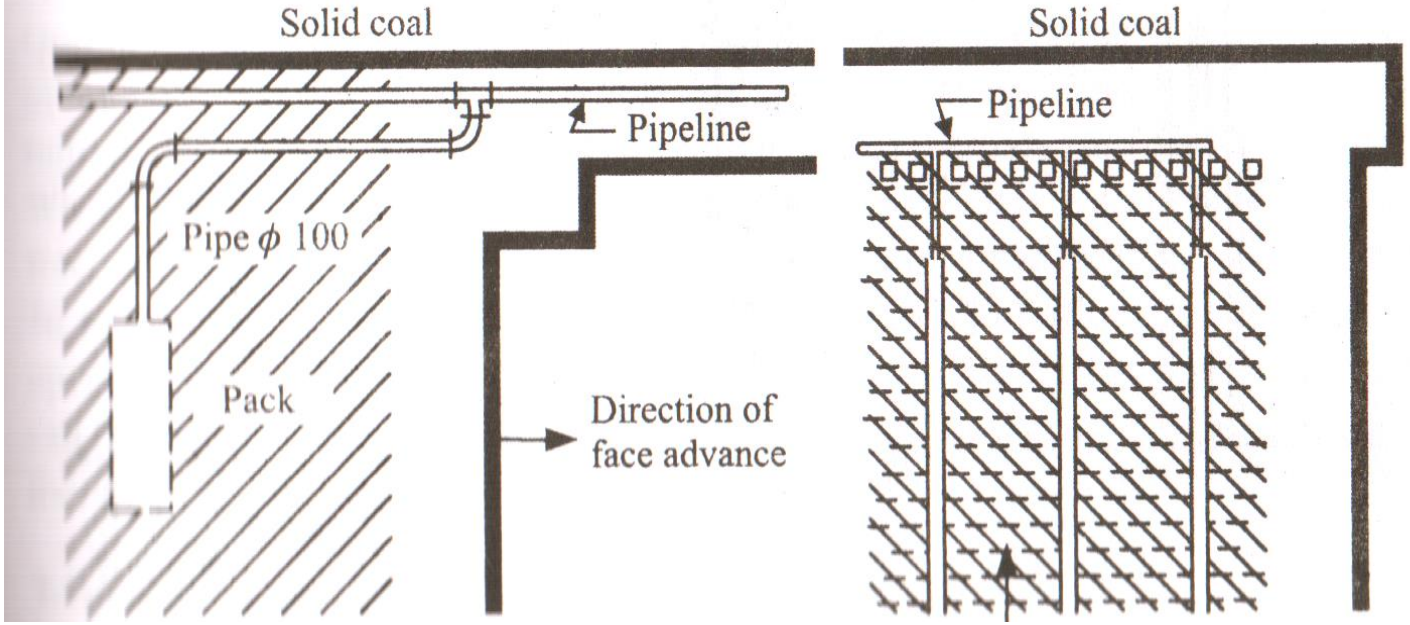
- can be effectively used in a coal seam having a good fracture permeability and a favourable cleat orientation.
- This can reduce methane emission at the working face by 80 to 90 % by blocking the migration of methane towards the face.

6. **Goaf/gob drainage**

- In very gassy mines, large quantities of methane may flow into the gob from the fractured strata above the coal seam.
- The large volume of the accumulated gas frequently poses severe ventilation problems.
- Gas cavities or corridors are left in the gob either parallel to the gate roads with an open caving of the gob or parallel to the face in the gob stowed pneumatically.
- Methane is drained under a low suction from the cavities through pipes connected to the drainage pipeline.
- In the conventional method, the cavities are constructed of timber lagging and steel wire mesh.
- This method had been employed as a secondary drainage method in some mines to drain gas which could not be captured by cross-measure boreholes or superjacent headings.



Methane drainage through gas cavities with caving of goaf.



Methane drainage through pack-cavities