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PROCESS FOR THE COLLECTION OF THE PIT GAS FROM AN UNDERGROUND COAL MEASURE

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ABSTRACT OF THE DISCLOSURE

Process for the collection of the pit gas from a previously and partly worked underground coal measure. This process comprises the hermetic sealing of the access roads to said coal measure and the extracting, at a relatively low pressure, of the gas forming the external gaseous phase in said coal measure so as to maintain said external gaseous phase at a relatively low pressure which considerably facilitates the passage of the gas from the internal and adsorbed gaseous phases in the rocks of said coal measure into said external phase.

The present invention relates to a process for the collection of the pit gas from an underground coal measure which has previously been partly worked.

The collection of the pit gas from a coal measure has already been affected in underground coal mines.

According to a known process for collecting the pit gas, the Hill process, the gas is sucked out of the coal measure through a system of pipes opening into the highest excavations of the mine workings of this measure during its working. This process of collection does not give a sufficient concentration of methane in the aspirated pit gas and does not justify the considerable expenditure necessary for its application.

According to a second known process for the collection of pit gas, the gas liberated from the stowings of the coal seam during working is piped to the surface. The pit gas collected by this process is also generally not very concentrated and is therefore of little industrial interest. This not very profitable process has been used chiefly for purifying the ventilation circuits of the mines in operation.

According to a third known process for the collection of pit gas, the gas is drained from the coal measure during working, either by adventitious bores drilled in the seam being worked or by rising or descending borings made through the walls of this seam from the passage of the bottom or top of the workings. This process is generally applied for collecting pit gas from coal measures during working. The pit gas obtained is usually sufficiently concentrated to permit of its industrial utilisation. Nevertheless, it constantly contains a certain amount of air, due to incomplete tightness of the bores. Therefore it generally has a methane concentration of about 80%, corresponding to about 20% of air.

According to a fourth known process for the collection of pit gas, the Hirschbach process, the pit gas is piped from the coal measure during working through parallel drainage galleries excavated above the group of coal seams to be worked. These drainage galleries are made before the working of the seams and can be completed by a network of boreholes perpendicular to the walls and running upwards or downwards, or parallel to the seams to be worked. The openings of the drainage galleries are stopped up by impervious barriers. In order to promote the removal of gas, a lowering of pressure of the order of 1 to 3 meters of water is applied to the measure. The pit

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gas collected by this process has generally a concentration of methane sufficient to be able to be used industrially.

A variation of the Hirschbach process consists in recovering the pit gas from a measure which has been worked or from seams being worked which underlie those which have previously been worked. In the latter case, the old workings are stopped up. These barriers, generally at controlled pressure, are frequently not very tight. Owing to this, the pit gas sucked up often contains appreciable quantities of air.

Another variation of the Hirschbach process comprises the digging of boreholes of large diameter to replace the drainage galleries, which are generally very expensive. The pit gas obtained then has a sufficient concentration of methane to be able to be used industrially.

According to a fifth known process of collecting pit gas the shafts leading to the previously and partly worked measure are sealed off and the pit gas is piped from the underground mine workings of this measure to the surface. The pit gas collected by this process has a high methane content and no longer contains air. However, this process has only been worked to a limited extent since the supplies of pit gas obtained have been small and decreasing.

The object of the present invention is a new process for collecting pit gas from a previously and partly worked underground coal measure. This new process differs from the known processes and more especially from that on abandoned coal mines, in that the gas forming the external gaseous phase in the coal measure is extracted at low pressure so as to maintain this external gaseous phase at a relatively low pressure which considerably facilitates the passage of the pit gas, from the internal and adsorbed gaseous phases in the rocks of the coal measure into the said external phase. The said new process considerably improves the degassing and the desorption of the coal measure and therefore enables the yield or the quantity of pit gas collected to be greatly increased. The fact that the yield of pit gas collected by the process according to the invention is greater than that obtained by the known processes is due jointly to the enormous contact surface between the coal measure and the mine excavations serving as a collecting network, to the perfect insulation and tightness of this network and this measure relative to the atmosphere, and to the reduction of pressure in the said network and the said measure relative to the atmospheric pressure.

Thus the new process enables a controllable, much larger quantity of pit gas with a concentration of methane equal to or greater than those which may be obtained by the best processes known, to be extracted from a previously and partly worked coal measure.

The whole unit formed by the previously and partly worked coal measure and by all the residual excavations of the earlier mine workings forms the collecting network and provides a permeability to the pit gas superior to that encountered in the known cases. In fact, the whole of the galleries and excavations resulting from the mine working forms an enormous collecting system for pit gas which, on the one hand, communicates directly with the collecting pipework and, on the other hand, with the multitude of breaks and fissures caused in the measure by the movements of rocks due to the mine workings. In addition, this considerable fracturing of the previously and partly worked measure increases the permeability of the rocks and thus facilitates the migration of the pit gas becoming desorbed from the unworked periphery of the coal measure.

On the other hand, the huge contact surface between the true volume of the collecting network and the rocks of the measure, a surface formed by that of all the excavated cavities and all the cracks and fissures, facilitates

the diffusion of the pit gas becoming desorbed from the unworked periphery of the measure.

The desorption and diffusion of the pit gas from the internal and adsorbed gaseous phases of the rocks of a coal measure result in phenomena which are dependent on the internal structure peculiar to certain rocks of this coal measure (coal and coal-containing schists). The specific internal surface of certain coals may attain, for example, 100 m.²/gram. The gaseous exchanges between the external gaseous phase of the rock and the internal or adsorbed gaseous phase and the gaseous phase adsorbed or fixed by the internal structure of this rock depend especially on the nature and the pressure of this external gaseous phase in contact with the rock, the nature and pressure of these internal and adsorbed gaseous phases of this rock, the magnitude of the contact surface between the external gaseous phase and the said rock, the nature, the internal structure, the permeability, the size of the internal surface, the temperature and the absorbent power of the rock in question.

In the present specification, external gaseous phase denotes the gas found in the part of the true volume of the measure which is exterior to the rock and which is formed by the residual volume of all the cavities due, for example, to the earlier mine workings and to the shafts giving access to the measure, internal gaseous phase denotes the gas found in the part of the true volume of the coal measure which is inside the rock and fills the free spaces of the internal structure of the latter, adsorbed phase denotes the gas found in the internal structure of the rock and covering the internal surface of the latter. The internal phase and the adsorbed phase of the gas which are adsorbed by the internal structure of the rock tend normally towards an equilibrium with the external gaseous phase, this equilibrium depending on the pressure of this external gaseous phase among other things.

In particular, it follows that the diffusion, the migration and the desorption of the pit gas adsorbed by the internal structure of the rocks of the coal measure are especially greatly facilitated by a reduction of pressure of the external gaseous phase.

From this and according to a feature of the invention, the gas forming the afore-mentioned external phase is extracted at a pressure which is near to or lower than the atmospheric pressure at the ground level and which is advantageously regulated as a function of the supply of pit gas to be collected.

Other details and features of the invention will appear from the description of an example of collection of the pit gas, to which the invention is not restricted.

In the case under consideration, the pit gas is collected from an underground coal measure which has been previously and partly worked. This measure has a volume external to the rock which is a residue from the earlier mine working and which is formed, on the one hand, by the shafts, the galleries, the workings excavated intentionally during this mine working and, on the other hand, by the breaks, fissures and cavities produced during and after the said working. In the example selected, it may be estimated that this residual external volume is about 10,000,000 m.³. On the other hand, the said residual external volume is filled with a gas denoted as "external gaseous phase."

Before the preparation for collecting the pit gas from this measure, the external gaseous phase has, for example, the following average composition of the air of the mines:

	Percent
CO ₂ -----	0.5
CH ₄ -----	1.5
O ₂ -----	19.6
N ₂ -----	78.4

On the other hand, this external gaseous phase is at a pressure of the order of 1 atmosphere and has a calorific power of about 190 K calories/Nm.³.

The above-mentioned residual external volume is de-

marcated by the rocks of the measure, which comprise, among others, coals and schists. These rocks contain a certain quantity of adsorbed pit gas. This adsorbed gas comprises an internal gaseous phase and an adsorbed gaseous phase. The said adsorbed gas is at a pressure of about 1 atmosphere in the vicinity of the contact surface between the external gaseous phase and the rocks and which increases progressively, for example up to 50 atmospheres, in proportion as one goes away from the degassed and desorbed zone of this contact surface towards the non-desorbed and unworked zone of the coal measure on the periphery of the mine workings.

The pit gas adsorbed by the rocks of the coal measure has about the following average composition:

	Percent
H ₂ -----	0.083
CH ₄ -----	98.387
C ₂ H ₆ -----	1.13
CO ₂ -----	0.40

and a mean calorific power of about 8.855 K calories/Nm.³. Before any operation for collecting the pit gas from such a coal measure, there exists in the interior of the said measure an unbalance of the pressure of the external gaseous phase and the internal and adsorbed gaseous phases. This pressure gradient involves a migration of the gas from the adsorbed and internal gaseous phases or of the gas adsorbed in the rocks, to the external gaseous phase.

The collection of the gas from this coal measure is prepared for by sealing the shafts and galleries, and more generally the approaches to the said measure. In a short time, the external gaseous phase, when there is air in the mines, reacts with the rocks of the coal measure through a complex but well-known phenomenon of oxyreactivity of the particular chemical structure of the coal.

After sealing the coal measure for a month, the external gaseous phase has the following average composition:

	Percent
CO ₂ -----	4
O ₂ -----	0.5
CH ₄ -----	51.5
N ₂ -----	44

Then the gas of this external gaseous phase is progressively extracted at low pressure.

On account of the progressive extraction of gas of the external gaseous phase, an unbalance is created between the pressure of this external gaseous phase and that of the internal and adsorbed gaseous phases in the rocks of the measure, this last pressure being about 50 atmospheres. The increase of this unbalance augments the actuating pressure gradient and accelerates the migration of the gas absorbed in these rocks towards the external gaseous phase.

Thus, by the extraction at low pressure in question, the rocks of the coal measure are degassed and desorbed from its constituent gas, while the above-mentioned external gaseous phase is enriched in methane and its composition becomes as follows:

	Percent
CO ₂ -----	3
CH ₄ (traces H ₂ and C ₂ H ₆) -----	92
N ₂ -----	5

this new composition corresponding to a mean calorific power of about 8,400 K calories/Nm.³ comparable for example with that of the public distribution of natural gas actually used.

The extraction of the gas from the external gaseous phase can be carried out at a pressure near to or lower than the atmospheric pressure at ground level. In addition, this pressure is advantageously controlled as a function of the yield of gas to be collected.

In connection with this and for a given condition of the measure, the above-mentioned pressure may be adjustably, for example, on the one hand, to an absolute

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value of about 780 mm. Hg in order to obtain a yield of gas of the order of 30,000 Nm.³ per day and, on the other hand, to an absolute value of about 750 mm. Hg. in order to collect a yield of gas of the order of 100,000 Nm.³ per day.

What I claim is:

1. Process for the collection of the pit gas from a previously and partly worked underground coal measure, comprising hermetically sealing all the access roads to said coal measure without sealing any of the internal passages of the coal measure from each other, and extracting at a pressure near to or lower than the atmospheric pressure at ground level the gas forming the external gaseous phase in said coal measure so as to maintain said external

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gaseous phase at a relatively low pressure which considerably facilitates the passage of the gas from the internal and adsorbed gaseous phases in the rocks of said coal measure into said external phase thereby to degasify the entire coal measure.

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