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Crop Cultivation in Abandoned Mines

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Abstract: Expounds the current status of the rising number of abandoned mines, sums up some mainstream of abandoned mine reuse idea, put forward the idea of cultivation of crops in the shaft, through the analysis of roadway surrounding rock stability, residual gas extraction and various key factors needed to make crops grow, and so on, this is a feasible and environmentally friendly concept.

Keywords: An Abandoned Mine; Gas Extraction; Green Mine; Cultivation of Crops.

1. Introduction

In recent years, all kinds of mining industries have developed rapidly, with a large number of resources being collected, the number of abandoned mines is increasing. How to make reasonable and efficient use of abandoned mines is a hot issue at present. First of all, using abandoned mines to build pumped storage power stations can not only break through the site selection restrictions of conventional pumped storage power stations in terms of drop, water source, environment, etc., but also has great significance for new energy side energy storage [1]. Secondly, geothermal energy is a kind of economic and environmental protection green energy, which exists in large quantities in abandoned mines. In summer, the water temperature of the abandoned mine water source is lower than the ground temperature, which can be used as a cold source. The heat pump transfers the user's heat to the cold source for heat exchange to achieve the purpose of refrigeration; In winter, the water temperature of the abandoned mine water source is higher than the ground temperature, which can be used as a heat source. The heat pump transmits the cold amount of the user to the heat source for heat exchange to achieve the purpose of heating [2]. In addition to the artificial introduction of water source, the seasonal rain is also one of the important sources of water source [3]. In addition, the rapid development of tourism has brought new hope to the transformation and development of the coal industry. Exploring the integrated development of abandoned mine and tourism industry is one of the important ways to solve the reuse of abandoned mine [4]. In addition, it seems to be a feasible idea to grow crops in abandoned mines, which will be demonstrated and analyzed from multiple perspectives as follows.

2. The Safety of Abandoned Mines

Safety is an important factor that should be considered first when the abandoned mine continues to be developed and reused. Secondly, the stability of roadway surrounding rock, the concentration of residual gas in goaf, the detection and distribution of groundwater must be monitored in an all-round way.

2.1. Stability of Abandoned Roadway Surrounding Rock

Roadway is one of the main areas for planting crops in abandoned mines, but there are many hidden dangers in many abandoned mines, among which the stability of surrounding rock of roadway is a more prominent problem [5]. The occurrence of coal seams in China is relatively complicated. Some abandoned mines, especially the senescent ones abandoned in the early stage, mined the shallow coal seams earlier, buried the roadway shallower and caused serious damage due to geological movement and other effects. The abandonment of the mine makes the roadway no longer artificially maintained, and its service life decays continuously due to the stop of maintenance. When the surrounding rock of the roadway is unstable and difficult to support or the area of the unstable area is too large and the cost of re-supporting exceeds the expected target, the reuse value of this area will be greatly reduced. Therefore, good roadway surrounding rock stability is the basis to ensure that crops can be planted smoothly in abandoned mines.

2.2. Gas Extraction and Mine Water Discharge in Abandoned Mine

In addition to the stability of the roadway, the extraction of residual gas is also a direct factor that directly affects whether crops can be planted. At present, the theory of gas extraction in abandoned mine has been perfected, but there are still many uncertain factors in the process of implementation. Especially under the influence of the large number of abandoned mines in China and the large difference of actual conditions, it is more difficult to make a complete statement. Therefore, a large number of theoretical analysis and field research is indispensable. The gob is the main gathering place of gas. During the production period of the mine, the goaf should be strictly closed. When the gas across the goaf may be enclosed in some closed Spaces, the stress across the whole goaf will be redistributed. This has a huge impact on the reuse of abandoned mines, on the one hand affecting human life and health, on the other hand because of the high concentration of gas in some areas is not conducive to plant growth. The gas permeability of coal strata is also a factor affecting crop cultivation. Drilling in the ground can increase the permeability of coal rock, but at the same time the cost cannot be ignored. Because the abandoned mine has been in disrepair

for a long time, the original underground environment may have changed dramatically. The mine water extracted during the production of the mine may have passed into the goaf and roadway, and a large amount of mine water accumulation will reduce the planting area of crops, and the unfiltered mine water is not conducive to the growth of crops. The gas extraction and drainage of the abandoned mine water are the guarantee for the smooth planting of crops.

3. Other Factors Affecting Food Cultivation

3.1. Light

Plants receive only a small percentage of sunlight; most of the rest is not used by the plant. The photosynthetically active radiation available to plants is located in the range of visible light 400nm-700nm, that is, red, orange, yellow, green, blue, violet and seven colors, but the wavelength range of sunlight covers the entire electromagnetic spectrum from X-rays to radio waves. Spectral analysis indicates that the effective radiation of red and blue light is the main absorption band of plants during photosynthesis. And green light, yellow orange light and far-red light and other trace light is involved in other metabolic processes of plant growth. The absorption degree of light in different frequency bands was different, which provided theoretical guidance for artificial light cultivation [6].

Different from traditional agriculture, which is highly dependent on natural climate conditions, modern agriculture has accumulated quite rich experience in improving crop planting area and yield with the help of scientific and technological means, among which LED lighting is one of the accumulated products of this experience. The idea is also applicable to grain cultivation in abandoned mines. LED (Light Emitting Diode), light emitting diode, is a kind of solid semiconductor device that can convert electric energy into visible light, it can directly convert electricity into light, the mine will be mainly through LED and other lighting equipment for crops required light. The reason for choosing LED is that it has the advantages of energy saving, longevity, environmental protection and low cost.

In the field of crop planting, and traditional agriculture mainly depends on sunlight, its output is susceptible to the natural environment is different, LED lighting refers to the use of unnatural light source and intelligent control system, according to the needs of crops on light, temperature and other conditions, the use of different wavelengths of monochromatic light combined, the light intensity, frequency, time span and other parameters for active adjustment and optimization, Artificial creation of suitable plant growth environment, in order to achieve increased production, high quality, disease resistance, pollution-free and other purposes, enhance the output capacity of crops.

3.2. Soil

3.2.1. Traditional Soil

Soil is the basis of plant cultivation, the preparation of soil is very important, the selection of soil is not good, often directly lead to the death of plants. Because the growth roots of potted plants are limited, so usually in the cultivation process of potted plants, the soil is required to be fertile, loose, breathability and water drainage should be good, and the content of organic matter should be high, and the microbial activity is strong, so as to ensure the normal needs of plant growth [6].

3.2.2. Culture Medium

The composition of most media is composed of five types of substances, namely inorganic nutrients, carbon sources, vitamins, growth regulatory substances and organic additives. The success of tissue culture depends to a large extent on the choice of medium. Different media have different characteristics and are suitable for different plant species and inoculation materials. When conducting tissue culture activities, the various media should be understood and analyzed so that they can be selected for use. The types and amounts of hormones in the culture medium vary from stage to stage and from material to material.

3.3. Temperature

Temperature is one of the important factors affecting plant planting, it not only affects the geographical distribution of plants, but also restricts the growth and development of plants, and has an impact on plant flowering. The change of temperature directly affects the physiological functions of plants such as photosynthesis, respiration and transpiration. The growth of each plant has a minimum, optimal and maximum temperature, which is called the three basis points of temperature. Generally, the temperature range of plant growth is 4-36 ° C. However, different plants and different growth stages have great differences in temperature requirements.

Tropical plants such as betel nut, coconut and so on require the average daily temperature above 18℃ to begin to grow; Subtropical plants such as camphor, small leaf FIG, Indian rubber FIG, bamboo, etc. begin to grow at about 15℃; Warm temperate plants such as peach blossom, purple plum, plum, etc., begin to grow at 10 ° C or even less than 10 ° C, and temperate tree species such as yew, spruce, and white birch begin to grow at 5 ° C [7].

Generally, plants grow faster with the temperature rising in the temperature range of 0-35 ° C, and slow down with the temperature decreasing. However, when the temperature exceeds the minimum and maximum temperature limits that the plant can tolerate, some organs of the plant are damaged or even the whole plant dies. Therefore, when selecting the crops that can be planted in abandoned mines, the influence of temperature must be fully considered.

3.4. Moisture

Water is the raw material for making organic matter; The amount of water affects the photosynthesis of crops, affects the absorption and transport of nutrients in crops, supports and maintains the tension of crop cell tissues, and makes plant stems and leaves straight; Water is the largest component of the object itself, it gives the plant transpiration, to regulate the plant body temperature and the whole physiological process; Water also affects the flowering, pollination, fertilization of crops and the occurrence and development of pests and diseases. In other words, the effect of water on crop growth is an issue that cannot be ignored.

The water needs of different crops vary significantly. Those with a long growth period, large leaf area and developed roots need more water. On the contrary, they need less water. For the whole growth period of a crop, the water requirements are generally less - more - less. That is to say, from sowing to the peak period of growth, mainly vegetative growth, water demand accounts for about 30% of the growth period; At the peak of growth, vegetative growth and

reproductive growth go hand in hand, and water demand accounts for about 50-60% of the growth period; After flowering, the volume of the plant no longer increases, and the water demand is less, accounting for only about 10-20% of the whole growth period. Take winter wheat in Beijing area as an example, sowing to the emergence stage, water demand accounted for 2.0% of the total water demand, the average daily water demand is 0.99 cubic meters/mu; From seedling emergence to tillering was 4.5%, and the average daily water demand was 1.29 cubic meters/mu; Tillering to wintering stage accounted for 9.4%, and the average daily water demand was 0.22 cubic meters/mu; Greening to jointing stage accounted for 12.1%, and the average daily water demand was 1.23 cubic meters/mu; Jointing to heading stage accounted for 30.3%, the average daily water demand was 3.74 cubic meters/mu; Heading to flowering accounted for 3.8%, the average daily water demand was 4.42 cubic meters/mu; Flowering to maturity stage accounted for 32.5%, and the average daily water demand was 3.51 cubic meters/mu. The total water requirement of the whole growth stage of winter wheat is 100%, the total water requirement is 345.39 cubic meters/mu, and the development and growth date is 264 days [8].

3.5. Transportation

Mine transportation originally refers to the underground transportation work of the mine, the main task is to transport coal, followed by the waste gangue out of the ground, the material and equipment to the underground use site, and transport personnel on, off work, etc. In the abandoned mine, the transportation system has been in disrepair and damage is inevitable. In order to transport seeds, soil and agricultural products, the complex transportation system can be selectively restored and maintained to meet the daily use.

On the ground, granaries are set up as a transfer station for crops. The railway track of the original mine can be used to export commodities, and heavy trucks can also be arranged to meet the short distance land transportation.

4. Intelligent Planting

In recent years, the digitalization and intelligent transformation of various industries in China is accelerating, and digital technologies such as 5G, AI, big data, cloud computing and IoT have benefited all walks of life. Intelligence is far from only intelligent mines, but also includes many fields including intelligent agriculture [9]. For example, agricultural crop monitoring, fine breeding and on-demand distribution of environmental resources have become a reality, agriculture is no longer "dependent on the sky" to eat, agriculture is entering the era of data intelligence.

Intelligent planting of abandoned mine crops mainly includes real-time monitoring system, temperature control system, sensors (including temperature, humidity, liquid level, CO2 sensors, etc.), plant lighting system, etc. Different crops have different requirements for the growing environment and planting laws. If the artificial management of these crops is relied on alone, it is likely to cause losses due to mistakes. Through the Internet of Things technology, targeted management can be carried out in different planting stages of crops, so as to reasonably adjust the growing environment of crops. For example, the water, light, temperature needed for crop growth can be adjusted through the Internet of Things, so that farmers can help develop the most reasonable management plan, so as to meet the growth needs of different kinds of crops. In order to realize the above functions of the Internet of Things in the abandoned mine planting, the user must first detect the mine environment by installing a sensor device, and determine the varieties of crops to be planted based on the test results. Secondly, after the crops have been planted, the information collected by the sensor can be used to understand the mine environment, and the mine environment can be adjusted through information and other regulatory devices, so that the environment can be kept in the best state at all times, providing a strong guarantee for the healthy growth of crops. Once again, in the stage of crop emergence, you can fertilize and water through the regulating device to ensure the normal growth of crops. At the final harvest stage, the types and quantities of crops can be counted through the Internet of Things, and the difference between cost and transaction can be measured, laying a good foundation [10] for the final sales.

What crops are most afraid of is pests and diseases. Once pests and diseases appear on crops, they will have a great impact on production and cause economic losses to farmers. Farmers cannot monitor the mine at all times, so the prevention and control of pests and diseases is limited, but through the sensor device of the Internet of things can achieve real-time monitoring of the mine, if there is an impact on crop growth and breeding of pests and diseases will be timely information back to the user, then the user can pass the information of pests and diseases to the relevant diagnostic department through the Internet of things. Then you can take the most effective means to control diseases and pests, so that the loss is minimized. In addition, the sensor can also determine the probability of pests and diseases by detecting environmental changes, and if the probability is too high, the user can take timely intervention measures to prevent the occurrence of diseases and pests.

5. Conclusion

With the continuous progress of society, high-rise buildings are rising from the ground, and pieces of arable land have become land for living. The arable land area of the country is decreasing year by year, and the crop reduction has become a serious problem that cannot be ignored today. Taking into account the stability of roadway surrounding rock, the extraction of gas from abandoned mines, and some essential elements of crop production, this is a new, bold and achievable idea. The expansion of food production and the use of waste is in line with the theme of the green era of contemporary society.

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