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Research Progress on Comprehensive Treatment and Utilization of Soft Rock Area

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Abstract

Soft rock is a common sedimentary rock and one of the main sources of coarse sand in the Yellow River. This paper systematically reviews the research progress of the treatment and comprehensive utilization of soft rock Area, including plant measures, engineering measures and chemical measures. In addition, the modification of soft rock can be used as building material and mine restoration material for comprehensive utilization, which provides theoretical and technical support for comprehensive treatment of soft rock Area.

Keywords

Soft rock; Omprehensive treatment; Development and utilization.

1. Introduction

Soft rock is a common sedimentary rock, which is composed of thick sandstone, sand shale and argillaceous sandstone of Paleozoic Permian, Mesozoic Triassic, Jurassic and Cretaceous, and its composition is between arkose and quartz sandstone. Due to small overburden thickness and low pressure, soft rock has low diagenetic degree, poor cementation between gravel and low structural strength [1]. It is characterized by being hard as stone without water and soft as mud when encountering water. It is extremely easy to be weathered and seriously eroded. Therefore, it is called soft rock. According to the color, soft rock can be divided into purplish red, gray white and red gray, with different colors, slightly different mineral composition and properties [2]. Soft rock is mainly distributed in the contiguous areas of Inner Mongolia, Shanxi and Shaanxi provinces in the Yellow River Basin [3].

The distribution area of soft rock belongs to arid and semi-arid area, with dry climate and concentrated annual precipitation, mostly rainstorm. Sparse vegetation, frequent sandstorm activities and serious weathering of rock strata lead to the broken terrain, more gullies and steep slopes in the soft rock Area. Soft rock is washed into the river under the action of water, and soil erosion is very serious. It is one of the main sources of coarse sand in the Yellow River. The annual input of coarse sediment ($D \geq 0.05$ mm) to the Yellow River accounts for about 62% of the total amount of coarse sediment input into the Yellow River. This area is also the center of serious erosion in the middle reaches of the Yellow River, with 30000-40000 tons ($km^2 \cdot a$) [4]. Therefore, the soft rock Area is the area with the most severe erosion and the most difficult area to control.

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2. Progress in comprehensive treatment of soft rock area

The comprehensive management of soft rock area is mainly to carry out vegetation construction with seabuckthorn as the main part. Hippophae rhamnoides is a kind of deciduous shrub, which is extremely drought resistant, wind sand resistant, and has relatively low requirements for soil. It was introduced into Ordos City in 1980s. In 1985, Academician Qian Zhengying put forward the proposal of "taking the development of seabuckthorn resources as a breakthrough to accelerate the control of Loess Plateau", and since then, he has started the research on the control of soil and water loss by Hippophae rhamnoides. The survival and growth of Hippophae rhamnoides in the exposed area of soft rock was tested in 1986 in the national "Seventh Five Year Plan" project "comprehensive management of the Loess Plateau - positioning of the experimental demonstration area of the fifth ditch in Zhungeer county" After treatment, the forest coverage rate in the soft rock Area of the banner has increased by 25.3%, and the sediment intercepted is 2 million tons per year [5]. In 1998, the State Water Conservancy Department compiled the feasibility study report on Seabuckthorn ecological engineering in Shanxi, Shaanxi and Inner Mongolia soft rock area, which started the ecological project of large-scale harnessing seabuckthorn in soft rock Area. Ten years after planting, the ecological environment has been improved significantly [6], and the soil erosion in the soft rock Area has been effectively controlled, and the sediment entering the Yellow River has been significantly reduced [7, 8]. At the same time, Bi cifen et al. put forward "Experimental Study on plant flexible dam in soft rock Area" in August 1992. Based on the principle of reducing resistance flow formed by water blocking by fluid obstacles in fluid mechanics, seabuckthorn plant cluster can pass through water, and divide the channel flow in soft rock Area through its branches, trunks and leaves to block sediment and form plant "flexible dam" [9] which can effectively intercept 70% of flood carrying capacity %~80% sediment with particle size > 0.05 mm [10, 11].

Because the soft soil layer of soft rock slope is too thin, Hippophae rhamnoides can only be planted at the bottom of erosion ditch. Therefore, there are also engineering measures such as gully head protection engineering and slope engineering, but it is difficult to popularize because of the large pores and water solubility of soft rock. In order to improve the anti scourability of sandstone, some scholars have proposed to spray anti arsenic agent on sandstone slope. It is an ecological restoration method of flexible slope structure formed by the combination of materials and biology. The special construction technology and water conservation measures are adopted to reinforce the soft rock and combine with the planting methods such as seed spraying to promote vegetation restoration and effectively improve the anti erosion ability of soft rock Area. Su Tao et al. used EN-1 curing agent to solidify soft rock slope in order to improve the stability of soft rock slope and reduce erosion [12]. Li Junjun et al. used modified water soluble polyurethane organic composite curing material (W-OH) to spray the slope surface, and found that when the w-oh spraying amount was 1.5 L/m^2 and the spraying concentration was 4%, the runoff scouring could be effectively reduced [13]. Shen Xin et al. sprayed W-OH-SF (modified hydrophilic polyurethane resin) anti-corrosion and promoting growth composite materials in soft sandstone area, and matched with micro irrigation, vegetation restoration and other technologies, and achieved good ecological effect of slope treatment [14]. The research and development of solidifying agent provides a feasible way to control soil erosion in soft rock area.

3. Development and utilization of soft rock

Soft rock can be modified and reused. Material modification is to change the material form or structure of raw materials by physical methods or adding chemical reagents, so as to change the properties.Soft rock contains alkali soluble minerals such as feldspar and vermiculite, which has pozzolanic activity. Therefore, the soft rock can be modified into cementitious material by alkali excitation, and the soft rock can be used as building material to realize the resource utilization of soft rock. Dong Jingliang et al. softened the soft rock after 28 days with slag powder content of 20%, NaOH 20%, density of 2.2 g/cm3 and water content of 6%, which met the needs of construction projects. The modified soft rock can be used as the construction material of warping dam [15, 16]. Yang

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Daling and others have effectively restrained the expansion characteristics of montmorillonite by using modifiers and gelling inhibitors, and built a demonstration project of silting dam with soft rock modified material in the small watershed of Huangfuchuan basin, the first tributary of the Yellow River [17]. Zhang Meixiang et al. used red arsenic sandstone instead of 10% river sand to prepare cement mortar without affecting its safety and durability [18].

Soft rock can be used as repairing material in mining area. Shanxi Shaanxi Inner Mongolia energy zone is a large coal chemical industry base in China. Coal mining can improve local economic benefits. However, in the process of coal mining, a large amount of waste gas and waste residue will be generated, and at the same time, a large amount of land will be occupied by the waste dump, so the mine area restoration is also one of the research hotspots [19]. Zhen Qing et al. reconstructed the better soil mass of the mine dump by mixing loess, soft rock and earth rock. In addition, soft rock has strong cation exchange capacity and can also adsorb heavy metals in mining area, which is environmentally friendly and cheap, and is a natural adsorption material [20]. Wen Jing et al. have shown that arsenic sandstone can significantly reduce the toxic dissolution of lead in soil, and can solidify lead in soil [21]. Soft rock is a potential material for sand remediation.

4. Conclusion

To sum up, the early comprehensive treatment of soft rock mainly focused on planting Hippophae rhamnoides to form a vegetation "flexible dam" to reduce the erosion of soft rock; due to the large pores of soft rock and water solubility, it is difficult to carry out engineering measures; therefore, chemical agent spraying measures have been taken to reduce soil and water loss. In addition, soft rock can also be used as a resource, which can be modified into building materials, and can also be used as the material for mining area restoration, and can adsorb heavy metals.

References

[1] Tang Zhenghong, Cai Qiangqiang, Li Zhongwu, et al. Study on interaction of wind erosion, water erosion and gravity erosion in soft rock Area of Inner Mongolia [J]. Journal of soil and water conservation, 2001, 15 (2): 25-29.

[2] Wang YC, Wu Yonghong, min De'an, et al. Investigation on soil erosion control measures in soft rock Area [J]. International Seabuckthorn research and development, 2007, 5 (1): 39-44.

[3] Wang lijiu, Li Changming, Dong Jingliang. Distribution and lithological characteristics of soft rock [J]. Renmin Yellow River, 2013.35 (12): 91-93 + 97.

[4] Xiao Peiqing, Yao Wenyi, Liu Hui. Research progress and control measures of soil and water loss in soft rock Area [J]. People's Yellow River, 2014.36 (10): 92-94 + 109.

[5] Zhang Zhanquan, Zhang Rui, Niu Xinnian. Ecological construction of Hippophae rhamnoides in soft rock Area has achieved remarkable results [J]. Soil and water conservation of China, 2000 (05): 30-31.

[6] GUI Ling, Zhang Zheng, Wang Juwei, et al. Application of BP neural network in ecological function evaluation of Hippophae rhamnoides [J]. Ecological science, 2011, 30 (3): 268-272.

[7] Xu Shuangmin. Summary of the implementation stage of ecological sand control project of Hippophae rhamnoides L. in 1998 [J]. Hippophae rhamnoides, 1999 (04): 43-44.

[8] Ma Chaode. Ensuring the afforestation quality of seabuckthorn [J]. Hippophae rhamnoides, 1999.12 (3): 25-27.

[9] Bi Cifen, Qiao Wang Lin, Hippophae rhamnoides flexible dam in the treatment of gully in soft rock area, [J]. Hippophae rhamnoides, 2000 (01): 28-34.

[10] Bi cifen, Wang Fugui, Li Guifen, et al. Sediment retention experiment of plant "flexible dam" in channel in soft sandstone area [J]. Sediment research, 2004 (2): 14-25.

[11] Li Hao, Yang fangshe, Su Shuzhen, et al. Experimental study on the influence of seabuckthorn "flexible dam" on sediment concentration and particle size distribution along channel flow [J]. Resources and environment in arid area, 2016, 030 (004): 102-107.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202101_7(1).0018

[12] Su Tao, Zhang Xingchang, Wang Renjun. Effect of EN-1 on shear strength characteristics of soft rock stabilized soil [J]. Acta agricultrual machinery, 2013.44 (09): 86-90 + 67.

[13] Li Junjun, Gao Haiying, Yao Wenyi. Study on critical quantity of w-oh curing agent for controlling soft rock slope erosion [J]. Renmin Yellow River, 2016.38 (06): 22-25.

[14] Shen Xin. A natural slope treatment technology of soft rock consolidation promoting growth [J]. People's Yellow River, 2015. 37 (08): 90-93.

[15] Dong Jingliang, Wang lijiu, Zhang Liqing. Experimental study on modified Yellow River soft rock composite material [J]. Renmin Huanghe, 2015.37 (01): 103-107.

[16] Dong Jingliang, Wang lijiu, Yang daling, et al. Experimental study on strength and hydration products of modified soft rock [J]. Renmin Huanghe, 2016.38 (06): 35-38.

[17] Yang daling, Zhang Tingting, Han junnan, et al. Study on Warping Dam Construction with modified pisolite sandstone [J]. Renmin Yellow River, 2016.38 (06): 42-45.

[18] Zhang Meixiang, Luo Zhongtao, Yin Huiling, et al. Preparation and properties of cement mortar with red arsenic sandstone fine aggregate [J]. Concrete, 2015 (08): 112-114.

[19] Tahir, K. and M. Ender. Some soil properties on coal mine spoils reclaimed with black locust (Robinia pceudoacacia L.) and umbrella pine (Pinus pinea L.) in Agacli Istanbul[J]. Environmental Monitoring and Assessment, 2009. 159(1-4).

[20] Zhen Qing, Huo Xiaoyan, Zhang Yinglong, et al. Simulation of water infiltration characteristics of soil with different configurations in Shanxi Shaanxi Inner Mongolia energy region [C]// Proceedings of 2015 Symposium on Soil and water conservation on both sides of the Taiwan Strait (Part 2). 2015.

[21] Wen Jing, Zhu Yuanjun, Zhang Xingchang, et al. Remediation of lead contaminated soil by arsenic sandstone in Shanxi, Shaanxi and Inner Mongolia energy region [J]. Journal of environmental science, 2015, 035 (003): 873-879.