土地工程百篇论文集

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前 言

土地工程是伴随着人类使用土地的过程而产生的，并随着人类的进步而发展，是一门实践性很强的学科。土地工程是运用工程手段解决土地问题，把未利用土地变为可利用土地，或把已利用土地进行高效利用，能动地协调人地关系和谐发展的过程，其核心任务是以土体有机重构为主体和研究核心，增加土地利用范围，提高土地生产力，满足有机生命体承载需求。

在我国快速工业化、城镇化发展的进程中，耕地和优质粮田的数量持续减少，不合理的土地利用方式导致了土地景观破碎化、生态功能退化与生物多样性下降等一系列严重的生态与环境问题。更令人担忧的是，优质耕地被占用和污损现象愈发严重，实施最严格的耕地保护制度、坚守耕地红线迫在眉睫，而其必须以全面提升耕地质量为前提。因此，土地工程不再是人们眼中的没有科技含量的简单集成学科，人们对土地工程的探索也不仅仅局限于有组织、有规划地归并地块、调整权属，改善农业生产条件，解决城市发展用地，为基础设施建设提供土地等等。

目前，解决土地问题，不仅要借助管理手段、经济手段、规划手段，更要融入工程手段，只有进行土地工程科学研究，并指导工程实践，利用综合手段解决区域土地问题，从根本上提升土地整治工程的质量，指导并挖掘土地多样价值、提高土地综合性能、科学管理土地，才能有力推动土地工程行业有序化、集约化、永续化发展，夯实生态文明建设，拓展人类生存空间。

目前，土地工程面临着工程技术要求高、科技含量需求增加、单一技术无法满足整治开发需要、整治技术要求多样化、综合化和集成化等一系列问题，而土地工程的科学试验及研究成果是土地工程理论支撑和技术实践的基础，可以指导土地工程的施工以及示范实践。因此，从事土地工程这一区间（或领域）工程技术的研究，并将其中规律总结形成理论体系，再用于规范指导人类科学使用土地，能够为土地工程提供科技支撑。

为推进土地工程学科建设及创新，加强土地工程论文成果的交流与推广，让工程实践得惠于此；同时，也为了鼓励科研人员积极地、深入地开展土地工程研究，真正推动土地工程科研成果的转化，我们从土地工程领域已经公开发表的论文中，撷取了一部分编印成《土地工程百篇论文集》。本书主要收录的是国土资源部退化及未利用土地整治工程重点实验室主任、陕西省土地整治工程技术研究中心主任韩霁昌研究员及其团队从 1991 年至今的论文，内容包括土地工程的概念、研究意义，沙地、盐碱地、废弃宅基地、裸岩石砾地等多种土地类型综合整治的理论、技术、方法及推广应用研究成果，共 100 篇，约 110 万字。该论文集在土地工程科学研究和土地工程建设方面有良好的独创性、前瞻性和启发性，可供从事土地工程相关专业的科研人员和管理工作者参考。由于时间仓促，加之篇幅有限，还有许多优秀论文未及收录，实为憾！

本书之出版，得到陕西科学技术出版社的热情支持，张扬、王欢元、李修成、朱德强、夏龙飞、马琳、徐娜、陈茜、庞喆、杨军军、马洪超、陈科皓等人兢兢业业，以高度的责任心和严谨的工作作风，全身心投入本书的编辑工作，为之付出了大量心血，在此，一并表示衷心的感谢！

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目　　录

Sand stabilization effect of feldspathic sandstone during the fallow period in Mu Us Sandy Land

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【**Abstract**】Depended on the analysis of ground snow situation, soil moisture loss speed and soil structure after planting crops of Mu Us Sandy Land remedied with feldspathic sandstone in the fallow period, it is concluded that feldspathic sandstone mixed with sand improved the sand stabilization in the governance of Mu Us Sandy Land in the fallow period. The sandy land remedied with feldspathic sandstone had big snow coverage, 25% ~75% higher than normal sand; soil moisture losses slowed down, and moisture content rose by over 3 times; soil structure had been improved, and water stable aggregate content increased by 6.52% ~18.04%; survival rate of protection forest increased to 85%; and ground flatness is less than 1%. The above conditions weakened sand rising conditions of Mu Us Sandy Land in the fallow period and formed two protective layers of snow cover and soil frozen layer under cold weather so as to prevent against wind erosion.

【**Key words**】feldspathic sandstone; sand stabilization; Mu Us Sandy Land; desertification; land consolidation

1 Introduction

Mu Us Sandy Land is a depression located at southeastern Ordos Plateau and north of northern Shaanxi Loess Plateau; it is one of China's four major sandy land (Han et al., 2012). Due to the long war damage in history, sharp population fluctuations, unreasonable land reclamation and overgrazing, serious grassland degradation (Liu et al., 2010), land desertification and low productivity have been caused in the Mu Us region (Kong, 1996). Serious land use issues, especially desertification and frequent sandstorm disasters not only destroyed the local ecological environment, deteriorated the natural environment, but also seriously affected the region's economic and social development, people's livelihood and production (Liu et al., 2014).

Though the research on desertification prevention and remediation has greatly progressed at present, the situation of "local governance and overall deterioration" still continues. The existing sand stabilization techniques mainly include engineering (or physical, mechanical) sand stabilization, biological sand stabilization, chemical sand stabilization and comprehensive sand stabilization (Han and Zhang, 2014). Engineering sand stabilization measures mainly use materials such as wood, grass, tree branches, pebbles to set obstacles on sand surface, and use grass square, nylon mesh, concrete slab, etc., to control flowing direction, speed and structure of windblown sand, change surface roughness, and realize wind prevention and sand stabilization. Its main features are efficient but with high cost, poor compatibility with biological environment and great implementation difficulty. Biological sand stabilization makes full use of the limited water and nutrients in the sand belt to plant trees, grass or shrubs to restore the vegetation, increasing roughness and governing the desert, it can properly protect ecological environment, but the bad climatic and hydrological conditions of desert or sand caused low plant survival rate and poor sand stabilization effect, unable to ensure long-term ecological benefits and rural sustainable development (Jiang et al., 2008; Liu et al., 2013). Chemical sand stabilization sprays or scatters dry chemical material on the sand surface to form sand solidification layer, thus avoiding the direct impact of air flow on sand surface, but generally, sand stabilization cycle is short, it is difficult to be applied and implemented in a large area. As far as large – area governance, the present prevention and remediation means have limitations, modern sand prevention engineering requires efficient, cheap, rapid, convenient and environment – harmonious sand stabilization technology. To sum up the features of the above several measures, adopting good points and avoiding shortcomings, developing comprehensive sand stabilization technology or discovering one multifunctional sand stabilization material to play a role in wind prevention and sand stabilization and enable the land to generate huge economic benefits will be of great significance for the governance of Mu Us Sandy Land.

2 Study area and methodology

2.1 *Study area*

Mu Us Sandy Land is in semiarid and arid climate area, belonging to inland plateau, far away from the Pacific, blocked by mountains, preventing the moist air mass above the Pacific from reaching the place, and moist air above southwestern Indian Ocean is also isolated by the Himalayas. In periphery and interior of Mu Us Sandy Land there is not any mountain land or forest with high precipitation as perennial supply of water source, it is only supplied by direct infiltration of 250 ~ 300 mm precipitation and beam land infiltration at side direction of catchment area, the supply is limited, belonging to typical temperate continental climate, with annual mean temperature 6.0 ~ 8.5℃, annual mean gale weather 10 ~ 40 d, and maximum 95 d. Gale duration of 1 d in Mu Us Sandy Land accounts for 60% ~ 70%, duration of 2 ~ 3 d about 20% ~ 30%, and 4 ~ 6 d about 5%, annual mean sandstorms 11 ~ 29 d, belonging to ecologically fragile agriculture – pasture ecotone. Annual prevailing windy season of Mu Us Sandy Land is from October to next May, being exactly the time of fallow period of crop cultivation in Mu Us Sandy Land. Feldspathic sandstone covers an area of 16,700 km^2 in the sandy land. Feldspathic sandstone alternated with sand in Mu Us Sandy Land has low diagenetic potential and structural strength. It is also highly subject to weathering and rapidly expands when it comes into contact with water, resulting in severe soil erosion (Ye et al., 2006; Wang et al., 2007).

The study area is located in Yuyang District (108°58′ ~ 110°24′E, 37°49′ ~ 38°58′N) of Yulin City in south of Mu Us Sandy Land and windblown sand grass land area, belonging to agriculture – pasture ecotone, having superior natural conditions compared with other regions of Mu Us Sandy Land, but wind erosion desertification and water loss and soil erosion were serious due to man – made sabotage.

Annual prevailing windy season of Mu Us Sandy Land is from October to the next May, when is exactly the time of fallow period of crop cultivation in Mu Us Sandy Land. The crop harvest reduces the surface vegetation cover on the one hand, on the other hand, causes the disturbance of land to a certain extent, thus creating conditions for the movement of sandstorm. Feldspathic sandstone covers an area of 16,700 km^2 in the sandy land. Feldspathic sandstone alternated with sand has low diagenetic potential and structural strength. It is also highly subject to weathering and rapidly expands when it comes into contact with water, resulting in severe soil erosion (Wang et al., 2007).

The existing researches show that, after mixing feldspathic sandstone with sand into soil in Mu Us Sandy Land, the soil's physical character can be improved, and moisture content of topsoil will be significantly increased. The Mu Us Sandy Land can play a role of natural water – retaining agent, providing a foundation for plant growth (Han et al., 2012; Yan et al., 2013). The snow covered on the surface of sand in the fallow period is regarded as a protective casing retarding windblown erosion, which has sand stabilization effect. After sand snow is melted, the exposed drift sand will generate sandstorm via wind effect, causing significant wind erosion phenomenon. It is discovered from the research of the sand of feldspathic sandstone settlement area and the original landform sand survey that, after snowfall, snow melting speed of remedied sand in this region is slower than that of the original landform sand. This paper is based on placement test and sampling analysis in test area to research the remedied land snow melting differences, reveal the formation of protective casing under wind erosion and influence mechanism of snow melting speed, and combines water retaining property and stability analysis of mixing feldspathic sandstone with sand into soil to discuss and research the sand consolidation effect of feldspathic sandstone in Mu Us Sandy Land.

2.2 *Research method*

2.2.1 Survey research of snow melting

This paper respectively surveyed remedied land covered with feldspathic sandstone and snow melting situation of original sand landform's sunny slope, shady slope and flat ground and underlying surface covered with snow. It selected slope aspect, gradient, elevation and other regions with similar terrain conditions for survey. During survey, six typical points in the study area were selected to measure snow thickness with plum blossom method, and average values were taken. Gradient of remedied land is very small, in order to get similar gradient and slope aspect for comparison, microtopography with mechanical ploughing was selected for survey. Specific terrain conditions at survey sites are shown in Table 1.

2.2.2 Method of water retaining property of soil mixed with feldspathic sandstone and sand

In the 70 × 70 × 50 (length × width × height) osmotic vessel, the migration process of moisture of mixture of feldspathic sandstone and sand was simulated. The specific procedure is to fill in sand at 30 ~ 50 cm depth, fill in mixed sample of feldspathic sandstone and sand (diameter within 2 ~ 3 cm) with a ratio of 1∶2 at 0 ~ 30 cm, connect lower part of vessel with ground, and simulate the mixing state of feldspathic sandstone and sand in the fallow period of land. Water was filled in the vessel containing mixture until the water oozes from lower part; 0 ~ 30 cm mixed sample of feldspathic sandstone and sand was collected respectively at 6 h, 18 h, 30 h, 42 h, 54 h, 102 h, 294 h, 318 h and 342 h after watering, and feldspathic sandstone rock mass was stripped out of the mixture, respectively to measure the moisture content of mixture of feldspathic sandstone and sand and feldspathic sandstone rock mass. In the meantime, only sand in another vessel was filled for comparison.

Table 1 Overview of the surveyed regions

No.	Landform type	Slope aspect	Gradient(°)	Elevation(m)
ZL-1	After covered with feldspathic sandstone	Sunny slope	17.3	1259
ZL-2	After covered with feldspathic sandstone	Shady slope	14.7	1259
ZL-3	After covered with feldspathic sandstone	-	0	1259
YS-1	Original landform	Sunny slope	18	1257
YS-2	Original landform	Shady slope	13.9	1257
YS-3	Original landform	-	0	1257

2.2.3 Method for stabilizing soil mixed with feldspathic sandstone and sand

Feldspathic sandstone and sand should be mixed into soil according to ratios of 1∶1, 1∶2 and 1∶5. We take total load as contrast, measure composite soil aggregate before and after utilization, select the sampling regions with the same condition of site (5 m × 5 m) for implementation, take samples with diagonal method in the region for three times and take the average value. The test method is the Savinov' method.

3 Results and analysis

3.1 *Analysis of snow melting phenomenon*

Table 2 Snow cover investigation list

No.	ZL-1	ZL-2	ZL-3	YS-1	YS-2	YS-3
Survey time	December 14, 2011, 11:30 a.m.					
Snow thickness (cm)	7.6	11.4	9.0	5.9	10.6	8.1
Snow coverage (%)	95	99	98	85	95	90
Thickness of ground dry soil layer (cm)	0	0	0	1.5	1.6	1.5
Survey time	January 5, 2012, 11:10 a.m.					
Snow thickness (cm)	4.8	10.7	8.7	0	10.0	7.5
Snow coverage (%)	85	95	95	<10	80	70
Thickness of ground dry soil layer (cm)	0	0	0	6.4	1.0	2.0

It snowed in Yuyang District of Yulin City on November 26, 2011, and snow thickness was 12 cm. After snowfall, snow melting situation survey (Table 2) was respectively performed twice on December 14, 2011 and January 5, 2012. The survey showed that, on the slope with the same slope aspect, the thickness of snow on the land remedied with feldspathic sandstone was bigger than that of original sand without remediation, the snow on remedied land melted slowly, and the snow on sunny slope of sand without remediation after snowing for 40 d was almost totally melted; from the angle of terrain, snow melting speed was sunny slope > plane > shady slope; frozen layer on remedied land appeared from the surface. When the sand was covered with snow, surface layer still had 1 ~ 2 cm dry sand layer (Fig 1a). After the snow on sand surface layer was melted, thickness of dry sand layer increased, within 5 ~ 8 cm.

Fig. 1 Dry sand layer with snow (a) and mixed land of feldspathic sandstone with snow cover (b)

After land remediation, feldspathic sandstone did not have dry sand layer after being covered, ground surface layer under original sand landform snow had one layer of dry sand layer. Sand soil without remediation had many non-capillary pores with good water transmission performance, and the melted snow water could rapidly infiltrate downward to sand layer; and feldspathic sandstone and fine texture, developed capillary pores, good water preservation, poor water transmission (Han et al., 2012) and high surface moisture content, which would be frozen as temperature drops, and surface layer snow melted slowly. Snow and soil frozen layer formed two protective layers on the surface, reducing the wind erosion effect in the fallow period (Fig 1b).

After land remediation with feldspathic sandstone, soil property and sand microtopography were changed. The following analysis of sand stabilization effect of feldspathic sandstone in the fallow period was made considering these two aspects.

3.2 *Effects of soil properties change on sand stabilization*

After the sand was mixed with feldspathic sandstone, soil character would be changed from sandy soil into silty loam, capillary pore would increase, noncapillary pore would reduce, and water preservation would improve. Improvement of water preservation of soil on sand surface layer and increase of soil moisture content changed molecular force among soil particles and helped the implementation of biological sand stabilization measures, thus improving soil structure and wind erosion resistance of soil.

3.2.1 Effects of mixed soil moisture change on sand stabilization

The lack of soil moisture is the biggest stumbling block for vegetation growth; insufficient moisture will cause earlier weakening of vegetation. Feldspathic sandstone itself has the effect of natural water retention agent, remedies Mu Us Sandy Land by mixing feldspathic sandstone and sand to improve water preservation effect of soil surface layer of sand and moisture conditions, and enables biological sand stabilization measures to constantly exert effect. Moisture content of sand soil is a very important wind erosion resistance factor. If surface moisture content increases, starting wind speed of sand grain will increase (Liu and Dong, 2002). When air flow blows over underlying surface consisting of loose particles, sand grain is affected by head resistance and gravity; as far as sand grain with grain size less than 0.1mm, the effect of cohesion and viscous force should also be considered. When the sand contains moisture, the strain between water molecule and sand grain particle would enable the cohesion among particles to increase, enabling it not easy to be risen. 2% sand soil moisture content is an important turning point, when moisture content is less than 2%, wind-blown erosion resistance is poor and change is big; when moisture content is more than 2%, wind erosion resistance tends to be stable; when moisture content reaches saturation capacity, extreme wind speed of wind erosion resistance is stabilized by about 14 m/s, which can resist Grade 6 ~ 7 gale (Dong and Qian, 2007).

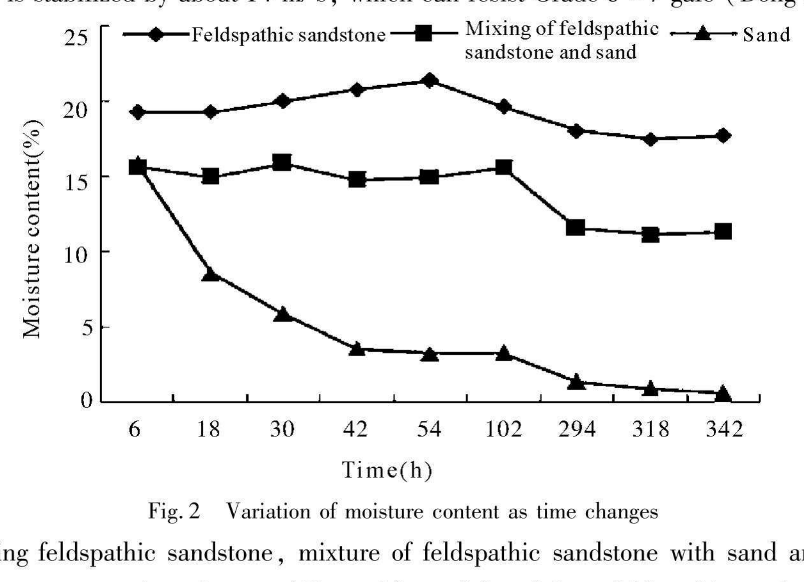

Fig. 2 Variation of moisture content as time changes

After saturating feldspathic sandstone, mixture of feldspathic sandstone with sand and sand, observed 342h soil moisture content as time changes (Figure 2), and found that, feldspathic sandstone and mixture of feldspathic sandstone with sand changed little as time goes, respectively 1.59% and 4.38%; and minimum moisture content was respectively 17.49% and 11.57%, exceeding sand's saturation moisture content, therefore, it could resist at least 14m/s wind speed erosion. When sand was observed for 294 h, moisture content was 1.39%, lower than 2%; wind erosion resistance became very poor. Therefore, feldspathic sandstone and sand was mixed by increasing moisture content of soil surface layer to improve windblown erosion resistance.

In addition, Mu Us Sandy Land has cold climate and high soil moisture content, which will generate soil frozen layer; if moisture content is low, it will be hard to form frozen layer (Table 2). On the one hand, after the water is frozen, it generates a large quantity of hydrogen bonds, the ice has tetrahedral crystal structure, and hydrogen bonds connect this tetrahedron into as a whole. Under the effect of ice, single – grain sand is cemented into one layer of protective casing to isolate direct connection between air flow and loose sand surface, thus can reduce the wind erosion.

Increase of soil moisture content is good for survival of protection forest. According to the erosion features in project area, the protection forest was placed with "net – shape" to form criss – cross forest protection belt, and supported with sea buckthorn, sand willow and other shrubs to form three – dimensional wind prevention and sand stabilization system. After land remediation, survival rate of protection forest could reach 85%; survival rate of aspen on the sand without remediation was 52% ~ 84% (Tai et al., 2004). Sand remediation with feldspathic sandstone provided advantageous conditions for biological sand stabilization.

3.2.2 Effects of mixed soil stability change on sand stabilization

Sand stabilization effect of Mu Us Sandy Land after mixing feldspathic sandstone with sand into soil is closely related to the stability of soil structure. Water stable aggregate means that soil structure form will not be broken after soil structure is immersed in the water, water stable aggregate is not only the important component of soil but also the productivity that ensures and coordinates liquid manure and gas heat in the soil, impacts type and activity of soil enzyme, maintains and stabilizes loose curing layer of soil and directly influences plant. Compare mixing proportion of feldspathic sandstone with sand based on 1∶1, 1∶2 and 1∶5, and water stable aggregate quantity in mixed soil before plantation and after one – season and two – season planting (Table 3).

Table 3 Mass percentage (%) of water stable aggregate of soil mixed with feldspathic sandstone and sand

Feldspathic sandstone∶sand	Before planting	One – season planting	Two – season planting
1∶1	28.22	29.29	29.33
1∶2	21.55	21.87	23.92
1∶5	18.38	18.02	20.82
0∶1(sand)	10.87	11.50	11.29

With the extension of planting time at different proportions, the quantity of aggregate in mixed soil tended to increase, indicating that soil structure had gradually cured and developed benignly. Compared with total load, if the sand was remedied with feldspathic sandstone, soil aggregate content would increase, and the added values were respectively: 7.51% ~ 17.35%, 6.52% ~ 17.79 %, and 9.53% ~ 18.04%. Sand remediation with feldspathic sandstone was helpful for increasing aggregate content, enhancing soil structure and intensifying the sand stabilization and soil formation effect.

3.3 *Effects of terrain factors change on sand stabilization*Land remediation engineering changed the sand's terrain conditions of original landform, discrepancy in elevation of sand's original landform was within 10m, flatness after land remediation was within 5‰ ~ 10‰, and the surfing sand dune was changed into flat ground, changing surface energy distribution and impacting the strength of wind erosion as well.

Sand dune was divided into sunny slope, shady slope, semi – sunny slope and semi – shady slope, the remedied land was flat without obvious slope aspect. According to the research (Fuh Bawpuh, 1958), radiating seasonal gross and annual gross of slopes at different slope aspects was different as latitude and gradient changed, and the variation trend was different as well. Especially in winter half year, radiating gross on south slope was much more than that of flat ground, and the higher the latitude was, the bigger gradient would be (but not more than the hottest gradient) and the bigger difference between them would be. For example, on the south slope with the hottest gradient (67°) at latitude 50, solar radiation gross in winter could reach 79.9 kcal · cm^{-2}, and solar radiation gross on flat ground in the same period was 80.2 kcal · cm^{-2}, both ones were nearly equal. In winter and the entire year, when the radiation on horizontal plane rapidly decreased as latitude increases, but solar radiation gross of radiation area on south slope with big gradient increased as latitude rose. Therefore, sunny slope received bigger solar radiation and had faster snow melting speed. After land remediation, solar energy distribution in the sand changed, latitude of Mu Us Sandy Land was within 37°27′ ~ 39°22′N, sun incidence angle in winter was small and snow melted slowly.

Wind is the driving force of windblown sand movement, the process of surface sand grain divorced from earth's surface under wind field effect and initial motion has become the start of sand grain, which marks the beginning of surface wind erosion. Under certain condition of wind direction, wind speed has always played a decisive part in the whole motion process of sand grain. Protection forest in project area effectively reduced wind speed (Bao et al., 2007). Compared with plane under this condition, when wind direction is fixed, windblown sand on slope is more easily raised (Wu et al., 2010). Windblown sand movement of the exposed cultivated land is different from windblown sand movement of desert, sand rising wind speed of cultivate land is faster than that of desert sand (Shen and Zou, 2005). After land remediation, ground gradient diminished, thus increasing wind speed of sand rising and strengthening wind erosion resistance of soil.

4 Conclusion

Land remediation for Mu Us Sandy Land with feldspathic sandstone changed soil conditions and terrain conditions of land remediation region and reduced windblown sand level of project area, especially feldspathic sandstone still has the sand – fixation function in the fallow period.

Feldspathic sandstone has water preservation effect that can expand sand soil moisture loss, increase soil moisture content, speed up sand rising wind, and enhance the soil's corrosion resistance. Due to high soil moisture content, earth's surface will tend to form frozen layer and snow coverage is big, reaching more than 85%. With the increase of cohesion, two protective layers of snow cover and soil frozen layer have been formed to reduce wind erosion effect.

In addition, soil moisture loss slowed down and moisture content increased by over 3 times. Condition improvement was helpful for promoting the implementation effect of the biological sand stabilization measures, increasing survival rate of protection forest to 85% and effectively reducing wind speed, thus mitigating wind erosion. Third, remediation of soil of Mu Us Sandy Land improved stability of soil structure through crop planting and increase of soil water stable aggregate content and provided advantageous conditions for sand stabilization effect of feldspathic sandstone. After land remediation, land flatness was improved and terrain factor of slope surface erosion was moderated.

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Land policy and land engineering

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【**Abstract**】Based on the relationship between land policy and land engineering, we defined the concept of 'land engineering' and its contents, and demonstrated the significance of the establishment of land engineering. On the one hand, the land policy guided the development of the land engineering. On the other hand, the land engineering is an important means to improve and execute the land policy. The contents of land engineering are summarized as follows: (1) conversion of non – agricultural land into agricultural land; (2) conversion of low standard use land into a high standard use land; (3) conversion of current land into human construction use; (4) conversion of polluted and damaged land into usable land. Our study provides scientific support for the efficient utilization of land resources.

【**Key words**】Land, Policy, Engineering, Discipline construction

1 Introduction

Land policy is a series of standards, directions and guidance for specific economic and social interests in order to achieve land use and management in a certain historical period. As land resources are non – renewable, the core content and basic objective of a land policy is to maintain the balance between the supply and demand of land resources via policy adjustment to achieve the sustainable use of land resources. The generalized land policies include the land laws, rules and regulations, while the narrowly defined land policies include all the land policies that are directly or indirectly made to adjust the relationship of humans and land. In either way, land policy is a directional and macro political behavior appearing as the attitude, norms and guidelines of the behavior makers (Lu, 2002; Chen and Han, 2005).

Land policy belongs to the category of production relationship and its relationship to land productivity is the conversion between adaptation and non – adaptation. The infiuence of a land policy on economic development requires people to continuously adjust the production relationship, as well as the land regime and policy, according to the corresponding productivity. At present, the social productivity has entered the rapidly developmental stage, which requires the land policy to be adjusted accordingly.

The essential contents of a land policy are as follows: (1) Land policy is substantially a performance of a production relationship and is one type of policy. Hence, policy theories are applicable to land policy, and all land policies should be consistent with the principles of policy science. (2) Regarding the characteristics of the land phenomenon, land policy emphasizes that the human – land relationship should be adjusted for specific economic and social interests, refiecting the constraints and guidance of the land policy on land possession, occupancy, use, income, distribution, operation and management. (3) Land policy should be made by the nation or political parties. Similar to the laws, the land policy serves the ruling class, which determines the class functions and the nature of the land policy. (4) Regarding the direction and objectives of a land policy, a land policy is made to achieve land management and utilization within a certain historical period. Hence, clarifying the goals and direction of a land policy can contribute to improving the accuracy of the policy definition. (5) Land policy is the sum of a series of guidelines and direction, which is aimed to adjust and guide the institutional or personal management and utilization of the land. As a land policy can be used to adjust the land ownership and benefits, it can significantly affect the relationship between the people and the state. Hence, land policy is the basis for the relationship between the land, the people and the state. The land policy should be implemented via specific techniques and methods, which can be provided by land engineering (Willamson, 2001). Land engineering aims to actively coordinate the harmonious development of the human – land relationship, using engineering means to resolve major land issues by such as converting unused land into usable land and low standard use land into high standard use land.

2 Data and methodology

This paper obtained some date and information form two typical land engineering, which were the Dajihan project in the Yulin City and the Chan – Ba Ecological District in Xi'an. This paper intends to elaborate the land engineering content and the relationship between the land engineering and land policy. Two typical cases are summarized as follows:

2. 1 *Dajihan project in the Yulin City, Shaanxi Province*

Located in the hinterland of Maowusu Sandy Land, Yuyang District of Yulin is a sand marsh area and belongs to agriculture pasture ecotone; due to man – made destructions, it suffers from severe wind erosion, desertification and soil erosion. Yuyang district is located between 108°58′ ~ 110°24′E and 37°49′ ~ 38°58′ N, with an altitude of 1000 ~ 1600 m. The ridge of the sand area is mainly Cretaceous red and gray feldspathic sandstone. The average temperature in the region for years is 8. 1℃, with the extreme highest temperature of 38. 6℃, and lowest temperature of – 32. 7℃. The annual average frost – free period is 155 days. The regional average annual rainfall is 413. 9 mm, annual evaporation is 1904 mm, average wind speed is 3. 5 m/s, the maximum wind speed is 18. 7 m/s and the maximum permafrost depth is 1. 48 m. Aeolian sand soil is the major soil type, accounting for 93. 4% of the total area. There is a large of sand and feldspathic sandstone, that cause soil erosion.

2. 2 *Chan – Ba Ecological District in Xi'an*

The Ba River is a river in Shaanxi Province; it originates in Qin – ling. This river was previously named the Zishui River, but the name was changed to the Bashui River because of the achievement of King Qinmugong. In the Qin and Han dynasties, there was a bridge called the Ba Bridge across the river, which was an important transportation hub in the ancient Shaanxi area. The Chan River and the Ba River are two of the eight main rivers in Xi'an. The Chan – Ba region refers to the region surrounded by the Chan River and the Ba River.

3 Results

3. 1 *Land engineering and its contents*

Land engineering can appropriately allocate land resources and organize land use in all aspects, from the macro aspect to the micro aspect and from the global aspect to the local aspect, to maintain an ideal land use structure and subsequently to obtain the greatest structural – functional benefits. Based on the current land use status, the objectives of land engineering can be classified into two categories: (1) unused land such as barren hills and wasteland, which can be comprehensively developed into usable land; (2) used land, of which the land resource value and utilization rate can be promoted by land engineering. Therefore, the core mission of land engineering is to increase the land use range and promote land productivity. In the modern society, land productivity is not only the agricultural crop output per unit area, it is also the benefits produced by all usable land, including agricultural land, industrial land, and land used for research, educa-