

THE COMPARISON OF SALT MINING AREA MANAGEMENT AND BRINE CAVERNS SURVEYING IN CHINA AND GERMANY

Qian Jianguo^① Ma Zhenhe^②

① Liaoning Technical University, Liaoning, China, 123000

② SOCON Sonar Control Kavernenvermessung GmbH, Giesen, GERMANY, 31180

Abstract

Through investigation on salt mining management departments, brine companies and brine cavern surveying company in China and Germany, a comparison is made to show the difference in mining laws, regulations, standards and brine caverns surveying between two countries. As results, salt mining management and brine caverns surveying have become regularization and standardization system in the legal and actual practice aspects in Germany. Brine caverns shape control and brine caverns fields information management are the characteristics of the system. Its core is a sustainable development system based on the full use and conservation of natural resources. In china, salt mining management adopts the same rules for coalmining, so there aren't specific provisions for salt mining management and brine caverns surveying in laws and standards. Because it doesn't take into account of the specificity of salt mining, it is not suitable for the case. With the extensive application of brine caverns in reserving fossil oil and gas and the further developing of brine caverns surveying technique, brine caverns surveying has been established in law as an important method of salt mining area management in developed country. In order to make full use and protection of natural resource, obtaining sustainable development, it is high time that the China government should take action and combine with the successful experience in Germany to develop salt mining management system and brine caverns surveying standards in China.

Keywords: Salt Mining Area Management; brine caverns; brine caverns surveying technique; mining laws, regulations, standards

1. Introduction^{[1][8][9]}

The salt solution-mining has a history of thousand years in China. Tracing back to 1041-1048 AD in Song dynasty, it had recorded a whole set of technique from drilling to salt production. It deserves to mention about the first thousand meters depth salt solution-mining well in the world which conserved in salt industrial museum in Zigong city of Sichuan province. Some professional said that the salt solution-mining technique is the fifth invention of china because it had significant impact on the salt industrial of the

world. In 1960s, a technique using brine cavern to store oil and gas was developed. By comparison with ground gas storage, those are main advantages that it can store a large amount of oil and gas, so it has a wide adjustment range; being economical; durability, it can run for more than 30-50 years; security. Because of all the advantages above, it becomes an important resource.

In Germany, the salt solution-mining also belong to mining and the government attach great importance to using and protecting it. In laws and standards, such as "Berggesetz",

"Markscheider-Berg Verordnung" and "Deutsche Industrie Normen(DIN)", there are provisions and describes for salt solution-mining and salt cavern storage. Brine cavern surveying technique leads a advanced position in the world, it works as main measure for government to supervise the companies and protect the resource of salt caverns.

In China, bedded salt formations distribution is wide and rich, determined by the requirements of geological conditions listed below: depth and thickness of bedded salt formations; the ratio of thickness bedded salt formations and rock interlayer; the salt proportion of; mechanical properties of bedded salt formations; geological conditions of mining area., only a few of them is suitable to create storage for oil and gas. Therefore China government should pay extra attention to protection of this natural resources.

2 The comparison of laws and standards in salt mining area management and salt carven surveying between China and Germany^{[2][3][4][5][6][7][8][9][10]}

It has similar requirements for application, modification and reservation of exploration and mining right in China and Germany. "Berggesetz" of Germany covers the main content of "Mineral Resources Law of the People's Republic of China", "Rules for Implementation of the Mineral Resources Law of the People's Republic of China" and "Law of the People's Republic of China on Safety in Mines". In china, salt mining management adopts the same rules for coalmining, so there aren't specific provisions for salt mining management and brine caverns surveying in laws and standards. Limited by surveying technology, besides the laws mentioned above, "Administrative Regulations on Salt Trading of the People's Republic of China", "Rules for Coal Mine Surveying of the People's Republic of China" and "Standardization of the People's Republic of China" don't have provisions for salt mining area management and there is no requirement for shape control and surveying of salt caverns.

In Germany, according to the particularity of salt mining, there are provisions in detail to make a definite requirement. "Berggesetz" demand brine company to provide Title Plan,

Industry Square Plan, Brine Cavern Plan, Elevation Monitoring Points and Subsidence Equivalent Curve Plan, Drilling Information Plan, Geology Information Plan, Salt Cavern Sonar Surveying Results and Salt Cavern Volume Table, etc. All these provide fundamental data for government supervising the production behavior of Brine Company.

It defines in the DIN21914-2: Mine plans - Drilling and cavern - Part 2: Brine caverns that Brine Cavern Plan should include the outline of brine cavern after horizontal projection, maximum horizontal section, elevation and depth of points represented the shortest distance between two caverns, elevation of wellhead and elevation and depth of the lowest casing shoe, volume of cavern, surveying date, etc.

3 Production Procedure of Salt Mining^{[1][8][9][10]}

In China, reserve management is the centre of management in salt mining area. Brine company is required to report their production to local land resources bureau every quarter. It includes: production in a quarter, average concentration of brine, analysis results of the chemical composition of brine etc. Annual reserves report will be reported to provincial bureau of land resources, it includes : geological prospecting information of this year, reserves at the end of last year, range of mining and exploitation information of this year, method and parameters for calculating reserves, mining-employed reserves of this year, mining-employed reserves of next year. The provincial bureau of land resources organizes annual inspection of mining right. The annual reserves report will be inspected by expert and then recorded in national reserves database. Since 2008, salt mining company is required to hand up the geologic plan and reserves estimation plan. The geologic plan includes: the boundary of mining area and coordinate of inflection points, the boundary of estimating reserves, the position and purpose of drilling. The reserves estimation plan includes: the boundary of mining area and coordinate of inflection points, the position of exploitation drilling, the wellhead and bottom position of producing well, the boundary and variety of reserves, mining-employed region, ect.

In Germany, the government focuses on shape control of brine cavern and position information between two caverns in a cavern fields. Before making a salt cavern, a company should hand up a design plan for brine cavern. It covers the purpose of salt cavern, for instance, making salt, oil storage or gas storage; The elevation and depth of top and bottom floor, the maximum diameter and volume of cavern, etc. On the procedure of making salt cavern, a periodical sonar surveying is required for brine cavern by Mining Bureau, normally 3-4 times each year. For oil storage or gas storage, the Mining Bureau required cavern sonar surveying every ten years and ground subsidence surveying each year. On the procedure of production, the brine company must hand up following documents: Title Plan, Industry Square Plan,

Brine Cavern Plan, Elevation Monitoring Points and Subsidence Equivalent Curve Plan, Drilling Information Plan, Geology Information Plan, Salt Cavern Sonar Surveying Results and Salt Cavern Volume Table, etc. All the maps are based on 1:1000 cadastral map, 1:1000, 1:5000 and 1:25000 topography map provided by government.

The title Plan is shown as fig.1, its main content are location of the enterprise, such as mining right information, sub-area information; the boundary of administration and water system; the boundary of mining right and coordinate of inflection points; the boundary related to security; the overlap area of different mine; the environment protection area if there is any; subdivision and numbering of the map and information of drawing the map.



Fig.1. the Title Plan

The Industry Square Plan mainly includes the boundary of mining right; landforms and objects on the ground; the elevation and depth of drilling; the elevation of wellhead, tracks of drilling, purpose of drilling; the facilities of the enterprise keeping stationary in two years on or under the surface; pipelines and communication cables belonged to other enterprises in the Industry Square; barrier salt pillar and protected area; sailing area, sailing lines and forbidden area for sailing if the mining area is offshore; the facilities of neighbor mining well; fixed section lines.

The Brine Cavern Plan includes Brine Cavern Plan and Vertical Section Plan as shown as fig.2 and 3. The Brine Cavern Plan and the Industry Square Plan work as a on and under ground comparison of a well, so the subdivision and scale should keep the same as much as possible. The Brine Cavern Plan mainly includes the maximum outline of the cavern which the cavern project on Geoid Surface based on the casing shoe, the elevation and depth of section being of maximum area; the position of caverns belonged to other enterprise in the region, the shortest distance between two caverns, the

name and length of section lines; subdivision and magnetic declination. The Vertical Section Plan includes the boundary of mining right; the elevation and depth of wellhead; the elevation and depth of top and bottom floor; the elevation and depth of Casing shoe after cementing with cement; the boundary of irregular parts of cavern projected on the

section lines; information of caverns belonged to other enterprise nearby. Furthermore, though it is not required by laws and standards, the elevation and depth of section being of maximum area, the lowest and highest position of sonar surveying also express on the map.

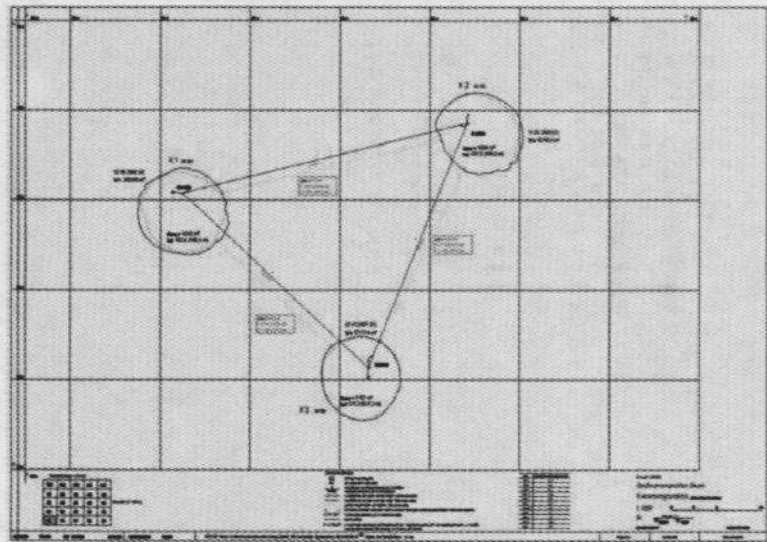


Fig.2. the Brine Cavern Plan

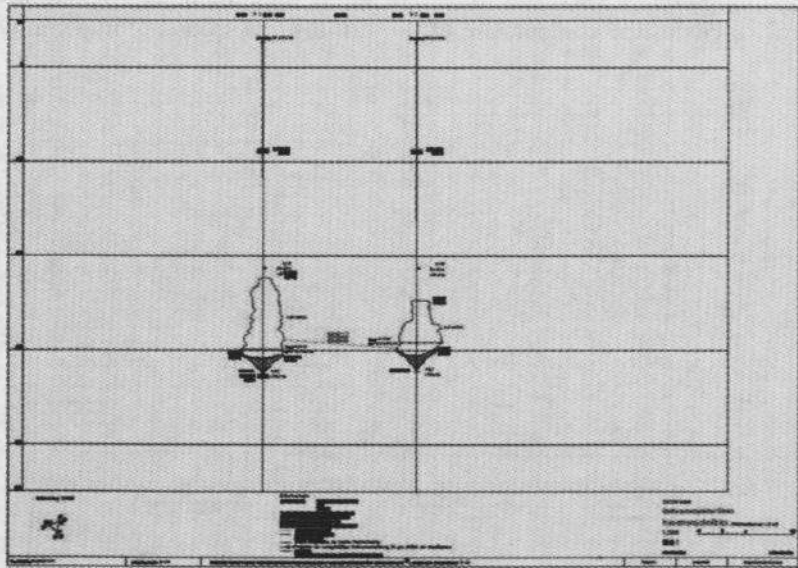


Fig.3. the Vertical Section Plan

The Elevation Monitoring Points and Subsidence Equivalent Curve Plan includes the position of elevation control points; landforms and objects on the ground; the results of elevation surveying. Normally, the

scale is 1: 5000, but it can adjust the scale according to the mining area. The Drilling Information Plan is demonstrated as fig.4 and it includes three parts. On the left is the drilling section map. There are the depth of drilling; the elevation,

depth and length of specific points; lithology of core; geologic age; gradient and direction of core every 100 meters; the section of drilling trace, the elevation, depth and length of making core sample; cementing information including diameter of drilling, diameter, thickness and material of tubing;

cement information including type, density, volume and date from left to right. On the top right is the drilling position map. At the bottom of map, There are some extra information, such as the enterprise which provides the geological and surveying data, cadastral information about mining region.

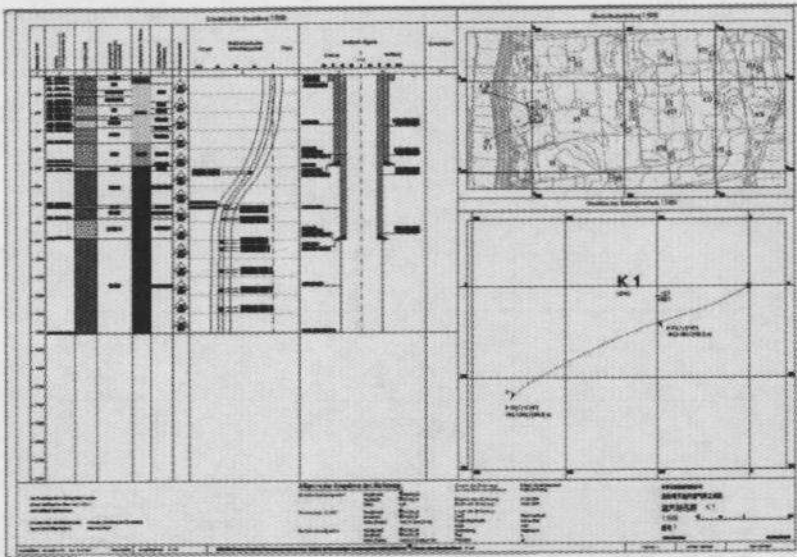


Fig.4. the Drilling Information Plan

The Geology Information Plan is illustrated as fig.5. it mainly includes the contour line of

top and bottom salt floor; the position of drilling and section of important direction.

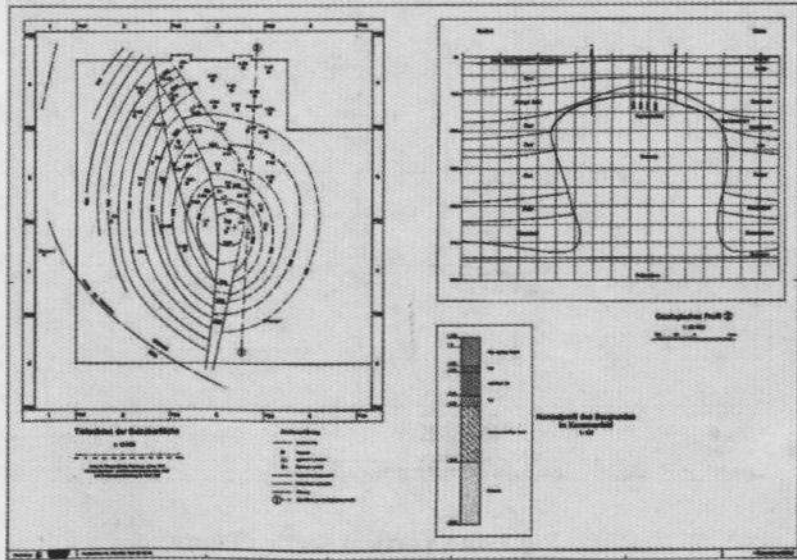


Fig.5.the Geology Information Plan

The Salt Cavern Sonar Surveying Results and Salt Cavern Volume Table mainly includes three parts. They are information of enterprise; fundamental data of salt cavern,

such as purpose of salt cavern, the depth of wellhead, the depth of top floor, the depth of the lowest casing shoe, permitted maximum height and diameter of cavern; the results of

sonar surveying, such as region of surveying, volume calculating by sonar surveying and chemical analysis, the depth of cavern being of maximum diameter, etc.

3 Conclusion

As results, salt mining management and brine caverns surveying have become regularization and standardization system in the legal and actual practice aspects in Germany. Brine caverns shape control and brine caverns fields information management are the characteristics of the system. Its core is a sustainable development system based on the full use and conservation of natural resources. In china, salt mining management adopts the same rules for coalmining, so there aren't specific provisions for salt mining management and brine caverns surveying in laws and standards. Because it doesn't take into account of the specificity of salt mining, it is not suitable for the case. Though, the large scale salt solution-mining is a matter of three decades in China, some of them have reached hundreds of thousands of volume, their maximum diameter and the shortest distance between them will approach or exceed the permitted diameter and distance. However, most of China's brine companies don't know the shape and relative position of caverns in cavern fields, in case of salt walls among caverns are being dissolved or the caverns are collapse due to maximum diameter exceeding the permitted value. It will do great harm to natural resources and environment. If it had happened in a region of oil or gas storage, it should be a disaster. With the extensive application of brine caverns in reserving fossil oil and gas and the further developing of brine caverns surveying technique, brine caverns surveying has been established in law as an important method of salt mining area

management in developed country. In order to make full use and protection of natural resource, obtaining sustainable development, it is high time that the china government should take action and combine the successful experience in Germany to develop salt mining management system and brine caverns surveying standards in China.

Reference:

- [1] Dr. Ma Zhenhe. Surveying in Salt mining area[J].Cooperation and Investment of Energy Industry. International Cooperation Center of the National Development and Reform Commission.2008
- [2] Mineral Resources Law of the People's Republic of China, Aug.29th, 1996
- [3] Rules for Implementation of the Mineral Resources Law of the People's Republic of China, Mar.26th, 1994
- [4] Law of the People's Republic of China on Safety in Mines, May.1st, 1993
- [5] Administrative Regulations on Salt Trading of the People's Republic of China, Mar.2nd, 1990
- [6] Rules for Coal Mine Surveying of the People's Republic of China,1989
- [7] Standardization of the People's Republic of China
- [8] Bundesberggesetz (BBergG), Aug.13th, 1980
- [9] Markscheider-Bergverordnung (MarkschBergV), Dec.19th, 1986
- [10] Normenausschuß Bergbau (FABERG),DIN 21914, Feb, 1999



Brief Introduction to Author:

Qian Jianguo, Male, born in Mar.37th, 1976, master of computer science, PhD Candidate in Geodesy and Survey Engineering. Main research fields are cavern surveying technique, error theory of surveying, application of computer technique and 3D laser scanner.