

# APPLICATION OF LASER LAND LEVELING TECHNOLOGY ON THE HARVESTER

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**Abstract:** The design about the application of laser land leveling system in the harvester is presented in the paper. It introduced the design scheme of laser land leveling system according to the work principle of salt harvester and its hydraulic control system which are used in our country. According to the long-term development, it is the development trend of harvester by actualizing laser land leveling technology to control harvesting of salt and improving its flatness.

**Key words:** Harvester; laser land leveling system; hydraulic control system

## OVERVIEW

From the mid-1970s, the laser land leveling technology began to be widely used abroad; in the 1980s, some developed countries like the United States, Russia and other countries employed the laser land leveling technology to level the earth, which can lower the cost per unit area in the plains and improve irrigation efficiency. Over the past decade years, developing countries such as India, Turkey, Pakistan, Egypt and other countries have used the laser land leveling technology for agriculture, highway and airport construction. Some divisions in China have also conducted relative researches; for example, China Agricultural University, Heilongjiang August First Land Reclamation University and China Institute of Water Resources and Hydropower Research and many other divisions have carried out the principle development and experimental research of the laser land leveling technology and made some achievements.

Some foreign enterprises have applied

the laser land leveling technology to the salt harvesti-

ng in the sea salt production, such as the United States, Australia, Mexico, and other salt-making enterprises. Using laser-control technology can simplify the physical labor of artificial leveling pool and plate after harvesting salt, improve brine irrigating efficiency and further improve our mechanical skill level for harvesting salt.

At present, Though dead dreg salt harvesters to harvest dead dreg salt in our country have achieved the mechanization and improved production efficiency and the level of sea salt production equipments, but there are still some issues: The degree of automation of the whole machine is not high; the depth of salt-harvesting is adjusted relying on the operator's experience or eye measure; after harvesting the flatness level of salt pond is not high. However, this flatness of salt pond is the important guarantee for next brine irrigation, solar salt and salt harvesting. As a result, the laser land leveling technology could be used to satisfy the need of

automation development of modern salt-harvesting to a large extent.

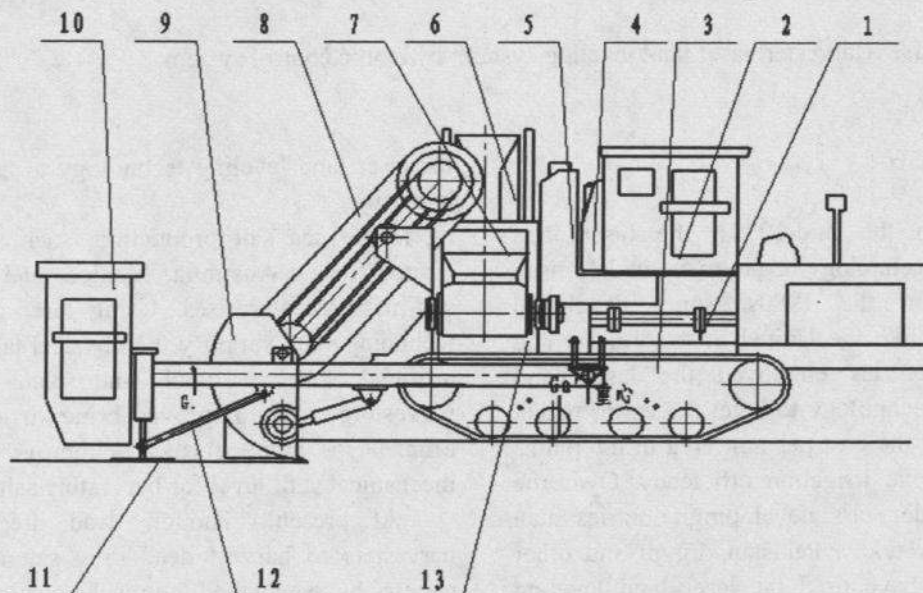
## THE PRINCIPLE AND CONTROL MODE OF HARVESTER

### The principle of harvester

When the harvester works (Fig.1), the salt-harvesting shovel will contact with the salt layer under pull force and its own gravity. Adjusting the angle-shift cylinder can increase blade's end angle and vertical force component; then the salt-harvesting shovel will be embedding in salt layer until reaching the required depth, and then adjust the angle-shift cylinder again to level the blade. At the moment, the salt-harvesting shovel cut the salt layer with a certain thickness continuously and evenly. Dead dreg salt layer is lifted in flaky and move up along the intrados through the shovel cutter; meanwhile,

they break and keep moving up along the intrados of salt-harvesting shovel; when coming to the top of shovel, the broken flaky salt will automatically fall into chain-type bucket elevator which is installed slopewise. After the lifting, in the role of gravity and Centrifugal force, these flaky salt falls into the conveyor belt. The center line of conveyor belt and vertical line of the harvester are vertical; the salt is then carried into transporting vehicles by rubber belt conveyor.

When salt-harvester is running, two cylinders (tank tray) can control the height of salt shovel and flatness, which are installed in the rear of harvester, and how to adjust the manual valve will depend on the operator's visual experience or eye measures. It is very obvious that the experience of the operator, visual error, the non-uniform of hardness of salt layers and the amount of salt on both sides would have impact on the formation of the salt bed in actual production.



1-assistant gear-box assembly; 2-main cab assembly; 3-undercarriage; 4-diesel oil box assembly; 5-hydraulic oil box assembly; 6-belt vehicle; 7-trough; 8-bucket elevator; 9-salt-harvesting assembly; 10-control room; 11-tray salver; 12-device of balance brace; 13-main-gear box;

Fig.1 The drawing of harvester structure

### Scheme design of hydraulic system

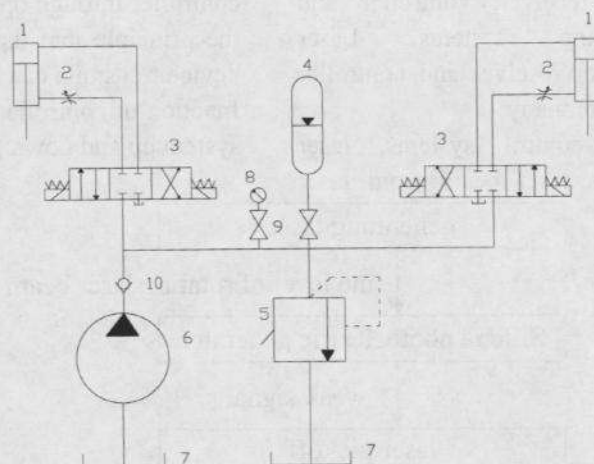
Laser land leveling system requires to control the stretch of two hydraulic cylinders (the fuel tank) separately and also needs to maintain a certain location; therefore, this system utilizes spillover valve for pressure release to keep pressure. Due to the effects of

gravity, the falling speed of salt-harvesting shovel is often too large, affecting the accuracy of entire laser land leveling salt-harvesting system; therefore, a one-way throttle valve is adopted to limit the stretching speed of telescopic hydraulic cylinder. As this system controls two hydraulic cylinders with



two sets of laser control systems, requiring two separate "three-position, four-way" electromagnetic directional valve. When harvesting salt, salt-harvesting shovel needs to adjust the height at times, thereby

hydraulic system requires to provide a great deal of oil mass instantly. So an energy accumulator needs to be installed as an auxiliary hydraulic power supply, which is shown in Figure 2.



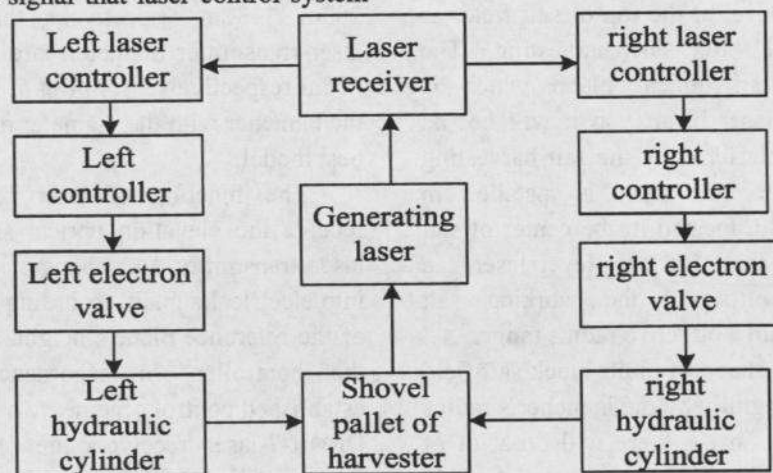
**Fig 2. Skeleton drawing of the hydraulic governing system**

1-hydraulic cylinder; 2-adjustable flow-regulating valve; 3-three-position four-way electromagnetic directional valve; 4-energy accumulator; 5-overflow valve; 6-hydraulic pump; 7-oil tank; 8.manometer; 9.cut-off valve; 10.one way valve.

#### Laser controlling mode

Two laser land leveling systems are installed in salt-harvesting shovel to control the hydraulic cylinder. When harvesting salt, as the height signal that laser control system

receives is the same, so salt shovel tray has always been able to maintain the same height level and horizontal plane when working (show in fig.3).



**Fig 3 Skeleton drawing of harvester control system**

It need hydraulic system to move salt shovel up and down very fast when it working. The adjustment process is: hydraulic cylinder rod throw out, the salt shovel is lifted up, and the depth of salt bed is reduced; moment of resistance includes the following

parts: the weight of salt-harvesting shove, crossbeams as well as coupling shaft, salt in the shovel and salt-layer resistance when the shovel is raised; Hydraulic cylinder shrinks, and the depth of salt increases as the salt-harvesting shovel gravity drop.

## THE DESIGN OF LASER LAND LEVELING CONTROL SYSTEM

### Principles of laser control

Laser land leveling control system is mainly composed of four parts; they are laser transmitter, laser receiver, controller and hydraulic-conditioning systems. Laser transmitter and laser receiver and controller are all from AGL Company.

In the laser-control systems, laser receiver receives a laser beam from laser

transmitter. After receiving the laser, converting silicon photoelectric generator to signal, and then through a series of circuit processing, transferring the deviation signal between the reference plane controlled by laser and the central reference point to controller through optical cable. According to the principle that the message laser receiver device transmits can drive solenoid valve, the function of controller to control the hydraulic system up and down (as shown in Fig. 4).

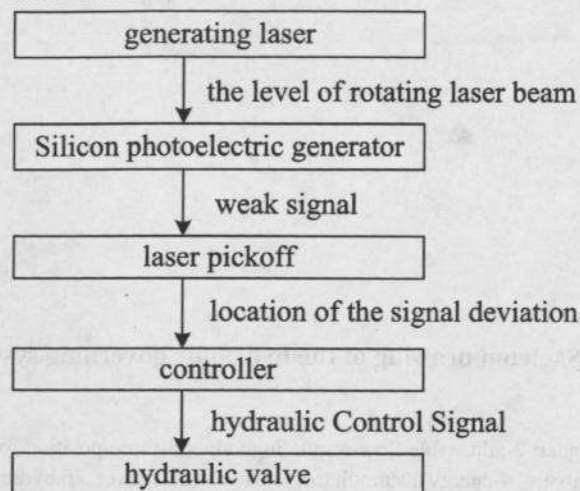


Fig.4 The principle of laser control system

### System Composition

When the laser generator is working, it forms a laser level at the top of salt field, as the base level for salt harvesting. The base-level is an optical plane which is composed by laser beams, so it will not be affected and interfered by the salt harvesting activities. Laser transmitter is installed in triangle scaffold, located in the center of salt field working area, the base-level laser can effectively control all the working salt harvesters within a effective radius range.

When the shape of multi-block salt field surrounded integrally by the launcher's radius is not a square shape, there will be a lot of inconvenience for the actual installation of the transmitter and repetitive waste; otherwise, when the shape is square, the more closer the diagonal length is to the launching diameter, the more convenient the operation is; the waste of human forces and resources is the least. For example: TIANJIN CHANGLU HAIJING GROUP CO., LTP has a 200m ×

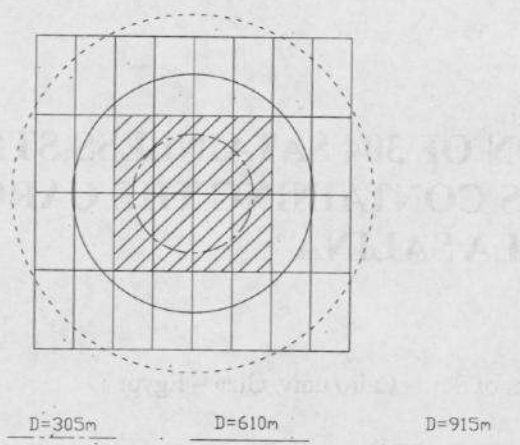
100m rectangular salt field, the diagonal length of square formed by the salt field is 283m, 1132m respectively; the three AGL laser transmitter diameters are 310m, 610m, 915m respectively; from Fig 5, it can be seen the launcher with the diameter of 610 m is the best model.

The function of laser receiver is to receive the elevation optical signal sent by laser transmitter and change optical signals into electrical signals according to the change of the reference plane's height, and finally to the controller. In accordance with the established control scheme, two systems AGL OMNI-7-laser receivers are chosen, which were installed in the vertical masts on both sides of salt-harvesting shovel, which should be higher than the cabin.

Controller aims to make data analysis to the potential signals laser receiver transmitted and then switch them into controlling signals to control the fuel mass and direction for lifting the hydraulic cylinder as the

electromagnetic proportion directional valve passes into the perching knife to achieve the automatically rising and falling of perching

knife. The controller model is AGL304, installed directly in the cab walls.



**Fig.5. The area of salt field and surrounded by launchers**

## SUMMARY

In our country, the application of the laser automatic leveling technology in mechanized salt-harvesting is still in the initial stage; but as the national economy continuously develops and salt industry enterprises progress in scientific and technological aspects, this technology has great potential. The technology can be applied to some basic aspects of salt field, such as pool repairing, pool arranging, road construction, road repairing, and ditch excavation, etc; therefore, it should attract more attention and concern of the whole industry.

## References

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