

# MODERN EQUIPMENT AND TECHNOLOGIES FOR MAINTENANCE OF HIGHWAYS

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Nowadays more and more attention in the process of maintenance and reconditioning of road base is paid to technical and economic aspects of application of new technologies and equipment. In this situation the cost of maintenance (repair) is the basic parameter of efficiency provision in comparison with reliability parameters and durability of road base, achieved during the process of maintenance (repair) with the use of appropriate equipment and technologies. The activity of the company Henan Gaoyuan Highway Maintenance Technology Co., Ltd (Gaoyuan Road Group) «Gaoyuan» is directed to engineering and creation of technological equipment and machines for maintenance of highways on the basis of the experience of road-building work fulfillment, which is the guarantor of their quality and reliability of output production and provides high engineering-and-economical performance of implanted technology.

## Introduction

Highway net is the most important part of transport system, which in general defines economic, social, and cultural development of each state. In this case, it is very important to plan rationally highways repair work, as well as streets network and its execution on modern high level, timely and qualitative work fulfillment on maintenance and operation of covering of roadway. etc. The solution of these tasks became a top priority of cooperation of key specialists of road departments of People's Republic of China (Company “Gaoyuan”) and the Republic of Belarus (BNTU). As a result of this cooperation the Chinese-Belarusian centre of scientific research in the sphere of road-building was founded, which has been successfully functioning for 4 years and which allowed to form an effective mechanism of cooperation in holding mutual scientific researches and engineering, which helped to quicken the mastering of modern technologies in the sphere of projecting, building and operation of highways. Providing the fulfillment of maintenance and highways repair work at world standard will allow to use special technology and equipment of “Gaoyuan” Company.

## About Company

Henan Gaoyuan Highway Maintenance Technology Co., Ltd (Gaoyuan Road Group) «Gaoyuan», is a leading road building enterprise in China. The company aims at constant engineering of new and perfecting existing technologies of diagnostics, maintenance and repair of road covering. Nowadays “Gaoyuan” is Chinese holding company, which contains research, building and industrial subdivisions.



Innovations and orientation on research has been the main priority of the “Gaoyuan” Company since its foundation. For 10 years the company formed professional research department with highly qualified staff of professors, PhDs (Doctors of Philosophy) and other highly qualified scientists. “Henan centre of engineering research in the sphere of maintenance of highways” and “Engineering research centre in the sphere of maintenance of highways of Xian” are successfully functioning as a part of the company. Besides, the company successfully cooperates with leading scientific and educational institutions of China.

Gaoyuan Road Group is one of the first highly qualified companies dealing with repair and operation of highways throughout China. Taking to consideration high responsibility and setting concrete aims at road-building branch, the company is orientating on scientific research potential and uses high technology for improving the quality of road industry in full and is specializing in introduction the results of its efforts into mass production. At this moment “Gaoyuan” company is a production association, which activity embraces the whole country. It is the enterprise, which fulfils all kinds of work in at road-building, road maintaining work, engineering service and machine production for maintenance and building of highways, road-building material production and its examinations and testing.

“Gaoyuan” company is an enterprise which activity is aimed at constant refresher training of its staff. The company was among first private establishments in the sphere of road-building, which was specializing in maintenance of highway road covering. “Gaoyuan” company first began to use in the road branch of China such high technologies as Chip Seal, removal of ruttedness with the help of Micro Surfacing technology, using emulsified bitumen and crushed rubber to road concrete mix for road building and number of other technologies. In building specification of Chinese Ministry of Communications rights for using such methods and technologies as modification of emulsified bitumen, technology of Chip Seal and removal of ruttedness with the help of Micro Surfacing technology belong to and patented by “Gaoyuan” company.

Gaoyuan Road Group includes 7 contractor enterprises, 3 companies providing highway road covering service, research center, a company, specializing in output of road-building materials and a company, dealing with machines and equipment for repair, maintenance and road building.



Affiliated company “Gaoyuan Sheng Gong” mainly involved in research, engineering, production and selling of machines for road maintenance, equipment for road covering diagnostics, experimental adjustments. This enterprise, which uses high scientific and technical engineering in its activity, one of the advanced scientific and technical enterprises of the Heinan province. It is a member of Asphalt recycling and reclaiming association (ARRA) and International Slurry-Seal Association (ISSA). A constant monitoring and introduction in the system ‘diagnostics-repair-maintenance’ modern long-range methodologies and methods is held by the company. At this moment, with an account of world experience and tendencies in the development of road sector “Gaoyuan” company produces following equipment for fulfillment of maintenance work of coverings:

- single and double surface treatment;
- surface treatment with use of rubber-bitumen binding;
- surface treatment with use of fibers;
- dispersion on the surface of emulsified bitumen covering and other impregnants;
- arrangement of thin-coat protective covering.

## Equipment produced by “Gaoyuan” company

1. Fog sealing is a way of maintenance of asphalt covering, allowing to fix crushed rock fines in a surface treatment immediately after its installation or to fill the interstices of newly established asphalt covering or running covering which is in good condition. For Fog Seal various emulsified bitumen are used. Fog sealing provides declination of breakstone ejection from surface treatment and prolonging covering life cycle for 1-2 years till overhaul.



2. Rejuvenator Seal is a technology which is similar to Fog Seal. The difference is that instead of emulsified bitumen for impregnation of asphalt covering special rejuvenate composite is used. Such kind of impregnation protects covering from deterioration and renovates its surface. Rejuvenator Sealing is also used in asphalt covering, which have axial and transversal fractions and provides inactive crack healing. This technology prolongs covering life cycle for 1-3 years till overhaul.

3. Scrub Sealing is a process during which the interlayer from modified binding (bitumen or emulsified bitumen) is arranged over old chapped covering with lots of cracks and fills them. Active cracks cannot be effectively filled by modified emulsified bitumen. For them it is recommended to hold Scrub Sealing on hot modified bitumen or on rubber-bitumen binding. The manufacture process is similar Rejuvenator Seal. This technology prolongs covering life cycle for 2,5-6 years till overhaul.



4. Slurry Seal is a cold composite which consists of breakstone of matched composition, binding (emulsified bitumen), fine aggregate and special additives. It is used for arranging durable protective wearing course of road covering. Slurry Seal is installed on old coverings for filling reflected cracks, roughness restoration and aesthetic view of the covering. This technology can be applied to highways, city streets, parking bays, all kinds of runways and any other coverings which need protective layer. Slurry Seal can be of different types. Type I is fine, for parking bays and runways. Type II is more coarse and is more frequently used. It is used in most highways and streets. Type III is the most coarse and is used in urban motorways.



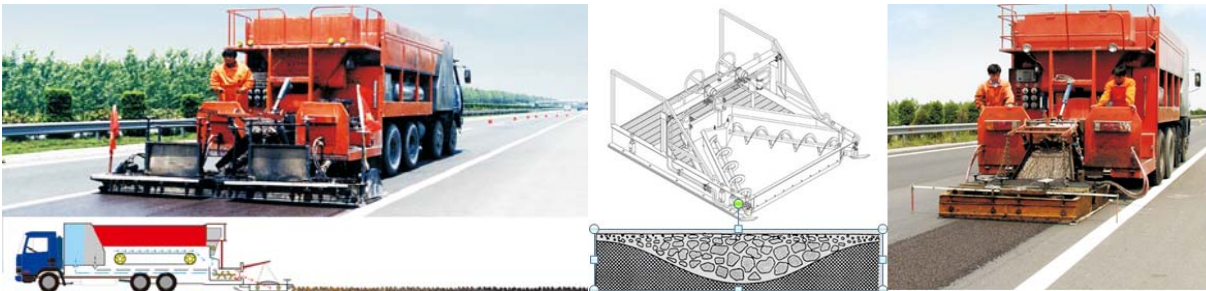
Slurry Seal can be installed with application of binding, which enhances its resistance to external actions. For its modification latexes, crushed rubber and other polymers are used. Slurry composite is prepared in a travelling



mixing plant. The exact compound is defined during the composite projecting in the laboratory. Application is done by the same machine through a special distributing appliance. This process is very quick, not expensive and effective. This technology prolongs covering life cycle for 2,5-7 years till overhaul.

5. Micro-Surfacing is a cold composite, which consists of breakstone of matched composition, binding (emulsified bitumen), fine aggregate and special additives. It is used for arranging durable protective wearing course of road covering. It is a kind of Slurry Seal, which is applied in special transport and weather-climatic conditions. Layers, installed according to this technology are thicker in comparison with Slurry Seal ones.

Micro-Surfacing is applied to such kind of work as disposition of a rut; restoration of an old covering profile; installing protective wearing course in specific cases of heavy traffic; quick repairing work (for example, at night time).



Macro-Surfacing is one of the technology variation. It is a porous cold composite, which consists of one breakstone fraction, plastic modified binder (emulsified bitumen), fine aggregate and special additives. This composite is similar to Slurry Seal, but is applied in specific cases, where it is important to provide noise reduction, good drainability and to reduce the probability of reflected cracks occurrence. This technology prolongs covering life cycle for 2,5-6 years till overhaul.

6. Chip Seal is a technological process of installing slim layers on road coverings in order to provide roughness, water resistance, wearability and covering density. The layer, installed according to this method is also called surface treatment. Surface treatments are used:

- As a preventive layer, which closes and prevents basic constructive layers of road covering from premature failure under bad weather conditions;
- As wearing layer prone to obliteration during traffic movement, preventing the road structure to the best advantage. Such layer needs only periodical renovation for giving the road structure initial qualities;
- As upper road covering layer with the roughness characteristics, which provide adhesion and a good surface-water drainage leading to significant falling of aquaplaning threshold and creating a good resistance to rime forming through boosted specific pressure.



Besides technical advantages, surface treatments have rather a competitive cost in comparison with a complex of road coat surface course which are used in such cases.

The most effective mechanism of surface treatment is a synchronal, practically simultaneous binding and metalling spreading.

While surface treatment arranging by conventional methods the time gap between binding spreading and metalling is limited by the cooling time of hot bitumen and can last for 1 hour. Using synchronal binding and metalling spreading the time gap between this actions does not take more than 1 second, which considerably influences surface treatment upgrading with the use of hot bitumen as well as emulsified bitumen as binding.



Upgrading with the use of hot bitumen as binding is explained by the fact that for so short period of time bitumen does not have time to cool and preserves thin consistency and high adhesive capacity. As a result bitumen is well pierced to breakstone and covering micropores, obducing each chip and firmly pastes them to covering and one to another.

There are several kinds of surface treatments and each has its own the most effective scope:

- single-ply surface treatment with single binding and breakstone spreading;
- single-ply surface treatment with doule breakstone spreading;
- double-ply surface treatment;
- surface treatment of ‘Sandwich’ type.

Nowadays the most effective and perspective variation of surface treatment mechanism is Fiber Chip Seal technology. The distinctive feature of this technology is that synchronal fibers spreading is made before metalling, which provide more endurance of surface treatment, especially on chapped coverings. This technology prolongs covering life cycle for 3-6 years till overhaul (for 4-7 years for Fiber Chip Seal technology).

7. Cape Sealing uses the advantage of two methods of covering protection. This technology consists of surface treatment arrangement, over which Slurry Seal or Micro-Surfacing layer is installed during some days. To prevent reflected cracks formation it is recommended to install surface treatment on bitumen modified by polymers or latex and also on rubber-bitumen bindings.



Cape Seals can be used as a protecting layer of the covering which is arranged on a long term for a heavy traffic covering and also for cracks elimination.

The usage of surface covering as a basic layer allows to get thick bituminous interlayer, which is impermeable and durable. The durability of bituminous materials depends on bitumen interlayer

thickness. Appliace of supplementary Slurry Seal or Micro-Surfacing layer not only improves covering evenness, but also attaches chips of surface treatment preventing their ejection. This technology prolongs covering life cycle for 4-9 years till overhaul.

Represented technologies provide getting saving rate on the average 3-9\$ per square meter in comparison with conventional technology of arranging layers of hot road concrete mix of 3 cm thick. The cata-

logue of equipment, which is necessary for realization of engineering solution of above mentioned technologies is provided below.

Nowadays repair and building technologies, which are based on recycling of going road base are more widely used in the world practice. To such kind of technologies refers the usage of cold weather concretes on organohydraulic binding agent (cement – emulsified bitumen). For preparation of such kind of materials for filling aggregate granulated asphalt is used, as it is a result of old asphalt coat recycling.

For the realization of the technology our company suggests using of modern mobile unit for concretes preparation on organohydraulic bindings of Chinese production GYCBL0200. The usage of concretes on organohydraulic bindings provides straight saving on road base installation stage during the new building, reconstruction and overhaul due to reduction in cost of materials about 10-15% of the road base cost with the constructive layers from hot road concrete mix.



### Conclusion

In the contemporary world technological innovations determine competitiveness of country's economy and provide high social standards, as no one world's country can provide leading positions in all spheres of science and technology by itself. So the actual task is widening of international technology transfer, scientific-technical and innovation cooperation, and also in road sector (for example the foundation of Chinese-Belarussian centre of scientific researches and road-building testing). "Gaoyuan" company is leading manufacturer of specialized road equipment in PRC. In the process of reciprocal cooperation it is able to realize mutual projects of various directions for satisfaction of needs of road sector enterprises of The Republic of Belarus, countries of CIS and the near abroad. It can do this on the basis of its great experience in introduction of modern technologies of maintenance and highway repair with the usage of high-quality technics and equipment of its own production.