Analysis of the Environmental Impact of Building Materials

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Abstract: Against the background of environmental problems in the field of construction this paper addresses the impact of construction materials on the environment and discusses the drawbacks of traditional building materials in the three fields of municipal highways building insulation and water supply and drainage and gives new materials or technologies in different fields to solve and optimize the problems. On the one hand, the advantages of new green materials are highlighted and combined with asphalt pavement regeneration technology on the basis of recycling to provide solutions for green road construction by comparing asphalt and warm mix asphalt. On the other hand, it involves new thermal insulation materials widely used in the field of building thermal and acoustic insulation such as the composite silicate thermal insulation materials mentioned in this paper which usually adopt the green production method and can effectively reduce energy consumption and reduce the amount of landfill. At the same time, the use of new insulation materials can reduce the building of traditional energy dependence the building of and energy consumption, and carbon emissions which are beneficial to the environment. Finally, it is clear that on the road of water supply and drainage construction, people should choose appropriate water supply and drainage construction materials to effectively reduce the waste of water resources and pollution and improve the efficiency and stability of the drainage system.

1 INTRODUCTION

Green materials for road construction building wall insulation and drainage pipes Nowadays some building materials have caused a series of impacts on the human living environment during construction and later use. For example, in highway construction, the toxic gas produced by mixing asphalt with cement ash affects the health of the human body and air. In addition, building materials face a long time of use and wear on the safety of residents to varying degrees. At the same time, the long-term harmful substances produced by underground drainage pipes affect ecological water resources. This shows the importance of new building manufacturing materials and the future development prospects of new materials. New building materials can not only bring unlimited benefits and convenience for future construction and development but also play a certain role in the protection of the ecological environment.

For example, in terms of road construction compared with the current and past asphalt paving methods and materials new materials such as asphalt mixture modifier paving can make the service life of roads longer in the future and also greatly improve the smoothness of the road surface. In addition, in the process of use, it is not easy to be damaged and repaired twice avoiding secondary environmental pollution. If it is eroded by sunlight or rain, it will not produce harmful substances that pollute the atmosphere thus protecting the environment.

In the same aspect of house construction, the wall insulation or doors and Windows of the future house can use new building insulation materials such as composite silicate and insulating glass which can greatly improve the service life of the house and ensure the life safety of the household compared with the current or past construction materials and the price is not particularly expensive reducing the construction cost. The builder can invest the cost in safety and service facilities.

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For urban drainage devices and the pipes used for discharge, many of the pipes are facing problems such as aging and damage which may lead to soil erosion or pollution. In the future construction process polymer polyethylene plastic material can be used which has excellent characteristics such as heat resistance acid and alkali resistance low permeability, and weather resistance, and is also easy to process and low cost. Not only can it ensure that the pipeline will not pollute the land underground but it can also improve the service life of the pipeline and its impact on water resources.

2 POSSIBILITIES FOR SUSTAINABLE DEVELOPMENT OF ASPHALT ON HIGHWAYS POSSIBILITIES

Materials play a very important role in road construction projects. Because of the impact of building materials on the environment, the rationality and sustainability of material selection should also be taken into account when selecting materials for roads. Reasonable and sustainable material selection can reduce the burden on the environment and improve the project's environmental performance. Asphalt as a common paving material has a wide range of applications due to its physical properties but it also raises issues related to the environment. Asphalt is black and shiny semi-solid at room temperature and will gradually melt when heated and it can dissolve in organic solvents with good fluidity thermal stability durable adhesion elastic-plastic electrical insulation and water resistance. It is suitable for paving asphalt pavements for medium and light traffic volume roads (Lu, 2019).

However, as a building material, its production and application can not avoid a series of environmental problems. During the actual operation of the asphalt mixing plant specific fuels need to be burned such as Coal heavy oil and other sources of energy may have poor fuel composition or combustion efficiency. And produce a small amount of industrial gases such as sulfur dioxide carbon monoxide and dioxide. Carbon reduction etc. Among them, sulfur dioxide has a relatively high degree of pollution in the atmospheric environment. Causing problems such as atmospheric voids or acid rain and the production of sulfur dioxide. Due to the insufficient purity of the coal and heavy oil burned in the asphalt mixing plant internal operations are dependent on it. It contains a small amount of sulfur and undergoes oxidation reaction with air during combustion. And sulfur dioxide was generated (Zhang, 2018).

Asphalt is generally transported in the form of petroleum or asphalt mixtures which require the use of large tanker trucks or pipelines for transportation generating large amounts of tailpipe emissions and resulting in high carbon emissions.

With the use of highways, asphalt pavements are subjected to the effects of vehicle compaction and weather erosion and require regular maintenance and rehabilitation work including asphalt coating which also requires significant heat and energy consumption.

2.1 Green Development Technologies on Roads

The pavement base will shrink during the gradual decrease in temperature which may cause cracks. The so-called temperature fatigue cracks refer to cracks formed due to temperature fluctuations in road environments with large and frequent occurrences. When the road is affected by the combined effects of vehicle load and constantly changing environmental temperature it will directly cause serious damage to asphalt materials exacerbating the severity of pavement structural problems (Sun, 2024). Conventional solutions are not economical and can damage the environment to a certain extent so we introduce a new green solution technology.

Asphalt pavement regeneration technology is a kind of technology to regenerate and reuse old asphalt pavement which helps reduce resource consumption lower construction costs and reduce waste generation. The process is crushing and mixing → hot regeneration → cold regeneration. First of all, the old asphalt pavement will be crushed and broken into smaller particles and mixed with additives. Then using a hot recycling plant, the waste asphalt is mixed with the new material through heating and mixing and the mixed material is heated to restore its viscosity and fluidity. In some cases, cold regeneration technology can also be used where the old road fabric is mixed with additives and directly laid and compacted on the road surface. The road fabric without the thermal regeneration process can be used to relay the road surface to form a new asphalt pavement.

Compared to the traditional asphalt pavement construction process of asphalt production asphalt pavement recycling technology only needs to consume relatively little energy reducing the consumption of non-renewable resources the use of recycled asphalt can also reduce the emission of harmful gases and hazardous substances less

pollution of the environment. Asphalt pavement recycling technology can be retained to a greater extent in the old pavement substructure only the old asphalt processing and recycling. This not only saves a lot of time and cost but also can maintain the stability and strength of the original pavement extending the pavement's service life (Bai, 2019).

2.2 New Green Pavement Materials

Warm mix asphalt is a new type of road material that is produced at much lower temperatures than traditional hot mix asphalt. Warm mix asphalt mixtures are typically produced at temperatures between 110°C and 140°C. The temperatures used in the production of warm-mix asphalt mixtures are much lower than those of conventional hot-mix asphalt mixtures. Compared to conventional hot mix asphalt warm mix asphalt mixtures can be produced and constructed with reduced energy consumption and emissions and better engineering performance and sustainability. Compared with traditional hot-mix asphalt mixtures warm-mix asphalt mixtures can significantly reduce energy consumption during the production process and the lower construction temperature can also reduce the impact of the construction site on the air quality and reduce harmful emissions which not only reduces the pollution of the environment but also conducive to the health of the construction workers (Zhou, 2024). The key to this technology lies in determining the aggregate grading types and contents of additives and mixing temperature. Among them, aggregate gradation plays an important role in the performance and pavement construction characteristics of warm-mix asphalt mixtures. In most cases, it is recommended to use crushed stone and limestone aggregates however the resistance of siliceous aggregates may be equal to or greater than that of limestone aggregates. Therefore by improving and modifying the performance of asphalt the quality and economic advantages of most siliceous aggregate mines can be fully utilized (Shen, 2023).

3 GREEN ENERGY-SAVING APPLICATIONS OF NEW INSULATION MATERIALS

The emergence of new insulation materials is very important for the environment and the sustainable use of energy resources. Traditional insulation materials usually have some problems such as environmental impact high energy consumption and short service life. New insulation materials Composite silicate material is a kind of thermal insulation material that has been improved and innovated in terms of thermal insulation effect environmental protection performance construction convenience and so on. Like insulating glass composite silicate materials these new insulation materials are widely used in construction furniture and other fields not only to improve the thermal insulation performance of the building but also help to save energy reduce emissions and protect the environment (Meng, 2022).

3.1 Common New Insulation Materials

There are many common new insulation materials. First of all like composite silicate insulation material, this material has a low thermal conductivity and can achieve a good thermal insulation effect even if the impact of a high temperature of 700 ℃ or more can work normally (Jun, 2024)). In addition, this material meets the basic requirements of environmental protection no dust pollution can be arbitrarily cut, and it can be convenient for construction. Furthermore such as a vacuum insulation board set up with a vacuum protection layer filler core material etc. the use of these materials can effectively reduce the heat conduction rate achieving very good environmental protection and energy saving effect. In the use of vacuum-insulated panels, the shell is in a vacuum state and can be filled with foam or fiber (Tao, 2020).

3.2 The Value of New Insulation Materials

New thermal insulation materials that have low thermal conductivity and high thermal resistance values can effectively block the wall inside and outside the heat transfer. In the winter heating period, the insulation material can reduce the indoor heat loss through the wall to the outside reducing the heat supply demand of the heating system; in the summer cooling period, the insulation material can block the outdoor high temperature to the indoor transfer reduce the load of the refrigeration equipment (Bai, 2019).

For an office building for example the use of 100mm thick rock wool board exterior wall insulation compared with the uninsulated annual heating energy consumption by 42. 3% of the annual cooling energy consumption by 31. 5% (Teng, 2023) the operating costs are significantly reduced. Therefore applying building wall insulation material is important for reducing building energy consumption and realizing building energy saving.

The use of new materials combined with waterproofing anti-cracking and other functions can build a highly efficient integrated thermal insulation system to improve the overall thermal insulation effect and reduce energy consumption. Specifically, the exterior wall is generally made of polystyrene boards concrete and other composite materials poured first with a special crusher to crush polyethylene plastic into particles it will be stirred into a pourable mortar and then coated in the internal and external walls of the building to make up for the inadequacy of the wall insulation but also to prevent cracking (Huang, 2019). This new composite material can not only improve the stability of the building but also improve its thermal insulation performance.

4 APPLICATION OF POLYMER POLYETHYLENE MATERIAL IN DRAINAGE

As we all know the cost of water supply and drainage engineering accounts for a small proportion of the total cost of construction projects and it is easy to be ignored in the construction quality management of construction projects. However, after the water supply and drainage project is completed and put into use its quality will greatly affect the normal operation of the construction project. Suppose the quality control is not strict in the construction of water supply and drainage engineering. In that case, it is easy to have quality defects such as deflection leakage or blockage of the installation pipeline which will affect the normal use function of the water supply and drainage engineering not only bring great inconvenience to the office or life of customers but also affect the good image of the construction enterprise. Construction water supply and drainage engineering involves a variety of sub-projects and its embedment work is cross-synchronized with civil engineering construction so the construction quality management of construction water supply and drainage engineering is difficult. How to do a good job in building water supply and drainage construction quality management is a problem that construction enterprises still need to solve. During the installation process, it is necessary to do a good job of real-time recording the details of the installation process and the overall progress of the accurate and standardized record. Generally speaking in order to ensure the overall quality of the installation process it is necessary to avoid the situation where the recording personnel are simultaneously installed by the installation personnel and avoid manual negligence caused by complex tasks. The recording personnel who understand the related technologies of the hidden pipe network should be equipped to record the work so as to facilitate later acceptance and maintenance. In addition, it is necessary to realize that the pipeline installation process through the wall through the foundation and other situations for these situations to be pre-judged must pass through the relevant areas should strengthen the protection of the pipeline to avoid leakage due to pipeline damage. New materials for drainage pipes and enclosures must be developed to reduce the high transport and installation costs of traditional materials and to improve the quality of construction. Secondly due to the increase in the speed and methods of mechanical installation traditional methods of quality control have proved to be inadequate (Ritzema 2006).

The main contents related to the performance test of traditional pipelines include the water leakage corrosion phenomenon accumulation of deposits increase of fluid internal resistance and excessive pressure loss. For such cases we have different solutions: for example, check whether the pipe connection is loose or damaged and repair or replace the damaged parts in a timely manner. Select corrosion-resistant pipe materials such as stainless steel or alloy steel and perform corrosion tests regularly; Clean the inside of the pipe regularly to remove attachments. Optimized pipe design with reasonable selection of pipe diameter and bending radius to reduce fluid friction resistance; Optimized pipe layout to reduce pipe length and number of breaks and reduce pressure loss.

UPVC pipe is a new type of material derived from the concept of energy saving and environmental protection which is widely favored and applied by construction units be of its advantages of energy saving environmental protection and low price. Compared with ordinary pipes this kind of pipe has lightweight strong corrosion resistance and a small surface roughness coefficient and the density ratio is only about 20% of the cast iron pipe. In the application and laying process in real life, the construction personnel can ignore the anti-corrosion treatment which can not only fully meet the construction needs of water supply and drainage engineering but also very high construction efficiency and quality. However, every advantage has disadvantages and this kind of pipe also has some defects in practical application. It is reflected in poor heat resistance and low compressive strength. It is necessary to control the medium in the tube within 45 ° C if it exceeds there is a certain security risk. At the

same time, there are also certain health problems in the water supply process of UPVC pipes because some chemical components need to be incorporated in the production and manufacturing process of pipes which will affect the water quality when mixed with water and cause harm to residents if they drink it.

High-density polyethylene PE pipe has various applications in various fields such as building water supply and drainage agricultural irrigation urban gas transmission chemical pipelines power cable protection pipes. Its excellent corrosion resistance wear resistance high temperature resistance low temperature resistance non-toxic and tasteless advantages so that it can maintain a stable structure and properties at various humidity temperatures. As people pay more attention to environmental protection and health high-density polyethylene PE pipes also have a clearer application prospect. Similarly reasonable and appropriate preparation work is the basis for ensuring the normal installation of water supply and drainage pipes. At the same time, Raw life cycle inventory data for the production of nanoclays from the mineral montmorillonite were collected for this case study in the United States. A life cycle inventory model was developed for the production of a drain pipe used in highway construction from cradle to gate which considers the sensitivity of model parameter inputs to the life cycle effects and cost outcomes of the three material choices. GHG emissions from nano-clay composite pipes were 54% lower than those from original HDPE pipes and 16% lower than those from original HDPE pipes (Long, 2017). Generally speaking, the following details need to be done in the preparation work: First according to the construction requirements design reasonable installation drawings of water supply and drainage pipes to provide a clear reference for the subsequent practical operation; Second according to the requirements of the drawings and the characteristics of the project with a reasonable number of professional personnel professional skills in place and according to the requirements of the drawings assigned to implement the responsibilities of each construction personnel; Third determine the installation technology needed to complete the requirements of the drawings on this basis prepare supporting installation materials and installation equipment and carry out the corresponding procurement work. If the preparation work before installation is not comprehensive enough and even if there are flaws it will make the installation process unpredictable problems and it will be difficult to deal with these problems in a timely and effective manner not only causing the extension of the installation cycle and waste of construction materials but also make the overall project quality difficult to meet the requirements. Therefore the preparation work before installation must be done to ensure that the requirements of drawings and the actual needs of the project are met on this basis to ensure that the installation technology can meet the requirements of the drawings and to ensure the technical level of each process(Huang, 2019).

5 CONCLUSION

The production of building materials consumes a large amount of energy especially some traditional building materials such as the asphalt mentioned in this paper whose production process requires a large amount of fossil fuels such as coal which leads to an increase in the emission of greenhouse gases such as carbon dioxide and exacerbates global warming. Therefore selecting environmentally friendly and sustainable construction materials is very important to minimize the environmental impact and promote sustainable development. This paper introduces different new building materials (warm mix asphalt mix composite silicate insulation UPVC pipe etc.) for highway housing and water supply and drainage projects and systematically analyzes their green production and excellent performance. On the other hand, this paper also introduces some emerging technologies for green construction such as asphalt pavement regeneration technology which can reduce the exploitation of natural resources and at the same time reduce the impact of the production process on the environment and reduce the generation of waste which is conducive to reducing energy consumption and emission reduction based on which it can also protect the original pavement substrate structure in the process of pavement maintenance and restoration reducing the destruction of infrastructure and helping to extend the road surface. In addition, it can also protect the original pavement base structure in the process of pavement maintenance and repair reduce the damage to the infrastructure, and help extend the service life of the pavement. Although all kinds of green building materials play different roles and target different directions their ultimate purpose is to save energy reduce emissions and protect the environment which also reflects that the selection and use of building materials should pay attention to their environmental friendliness and sustainability.

AUTHORS CONTRIBUTION

All the authors contributed equally and their names were listed in alphabetical order.

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