

Ecological Regression of Urban Pavements —Porous Pavements

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Abstract: This paper introduces the structure of Porous pavement and studies the superiority of porous pavement in ecological protection, including such aspects as the improvement on the thermal, sound and luminous environment, the supplement of the urban groundwater, the effective utility of the rain-water ,cleansing of sewage and urban flood control in urban areas. The Application of porous pavement embodies the regression of urban pavements. Some advice is also suggested.

Keyword: porous pavement, ecology environmental benefits ,ecological regression,

1. THE BACKGROUND

One of important features about urbanization is that impervious pavements replace the original natural soil and vegetation. The permeability of natural soil and vegetation has been changed. Urban harden pavement occupies considerably ratio in urban area, so its ecology environmental benefit has an very important effect on urban ecological environment. Inner structure of porous pavement has a serious porous frameworks and satisfy the needs of strength and durable property . The interior framework of the porous pavement is formed by a series of porous structures connected with the outside air. And at the same time it can meet the requirement of strength and durability. ^{[1] [2]} Porous pavement which including ecological porous concrete is similar grassland and soil texture because of its good permeability and moist condition. ,so it gives expression to the ideal of "sympathize with environment" and "ecological regression" awfully. Fig. 1 shows the ecological concrete with grass plant developed by the material department of Southeast University.



Fig.1 Ecological concrete with grass plant developed by material department of Southeast University

2. ECOLOGY ENVIRONMENTAL BENEFITS OF POROUS PAVEMENT

Ecology environmental benefits of porous pavement manifest in the following:

2.1 the affect of porous pavement in supplementing urban groundwater

Most of traditional impervious pavements collected rainwater by making the surface slope of pavements and using the corresponding drainage pipeline, then these collected water was drained into urban drain pipe. It is not good for the effective utility of the rain-water . Porous pavement can relax the adverse influence of conventional impervious pavement. Through its pervious route, porous pavement permeate rain into soil, the rain is also purified by filtrating in soil. The storm water fills up the void spaces of porous pavement and slowly percolates into the underlying soil mantle. Groundwater in urban area is supplemented. In the meantime precipitation which is clean comparatively can permeated into underground in order to avoid being polluted. It is also benefit to with the plant's irrigation.

2.2 the affect of porous pavement in improving sound and luminous environment in urban area

Test researches on noise reduction through sound absorption of porous concrete pavement and porous ceramic bricks are developed. Our researches discusses the changing laws of sound absorbing performance of different porosity porous concrete pavement and porous ceramics bricks. A regression equation between the porosity of porous concrete pavement and its average sound absorption coefficient is obtained. When thickness to 6cm, the

experience formula about effect of the sound absorptions coefficient and porosity for concrete penetrative pavements as follows:

$$\alpha = 0.1935 - 0.00546 V_v$$

Which: V_v —porosity (%); α —sound average absorptions coefficient.

This equation can evaluate the sound-absorbing ability of different porosities of porous concrete pavement. This experience formula has some reference value for the optimal designing of porosity for concrete penetrative pavements^[3].

The surface small hole of porous pavement cause the surface light to diffuse, so it can avoid the glare created by directional reflection on the surface of the polished slab stone and brick. Porous pavement can clear up the rain water on the surface promptly, so it can overcome the weakness of 'floating', 'splashing' and 'glaring'. By this measure, porous pavement can improve traffic safety.



Fig.2 Ecological concrete plant brick pavement in Kaiyuan temple, Fujian, Quanzhou

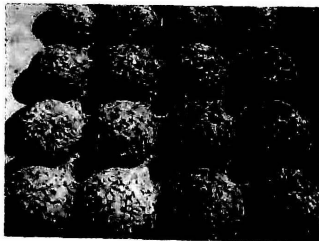


Fig3. Ecological concrete balls developed by material department of Southeast University

2.3The affect of porous pavement in improving 'heat-island effect' in urban area

The rain water that detained in porous pavements and its lower fills evaporates and absorbs a great deal latent heat and reveals heat by solar radiation. The air temperature and pavement surface

temperature is dropped. 'Heat-island effect' is lightened effectively. Tests of evaporation and cooling of porous concrete pavement and porous ceramic bricks are carried out under the condition of simulative heat radiation and ventilation. The results of the tests show the changing laws of the evaporating and cooling performance of different porosity porous concrete pavement and porous ceramics bricks. These results provide reference for the optimal porosity design of evaporation and cooling of porous concrete pavement and porous ceramics bricks^[4]. The steam evaporates from porous pavement can add air humidity, so it can lighten 'urban dryness'. This way can also reduce the harm of "dust storm." An hourly measurement and analysis of the summer thermal environmental index (temperature, humidity and sun radiation) on Nanjing's typical squares has proved this point^[5]. Meanwhile, evaporating added the air humidity, this way could improve "dry heat". One of the reasons that the "dust storm" in less rain season of north cities was that the air's humidity was too low. The research of Japan environment department which directed against 'heat-island effect' in Tokyo stated clearly that one of the effects by 'heat-island effect' was clouds of dust flying up because of less evaporating and dry air. One of the measurements to solve this problem was the application of porous pavement.

2.4The affect of porous pavement in improving ecological environment in the earth's surface.

Porous pavement possess favorable abilities of retaining water, ventilate and permeable. It satisfied the pavement demand, it also has a series of advantages just as natural vegetation and soil. So it can reduce the degree of destroy caused by impervious pavements. The survival space of animal and plant under porous pavement is protected effectively. Depending on its own porous structure, the porous pavement in water can create a favorable environment for some aquatic animals and plants. These aquatic animals and plants can grow well in this surface. Fig.2 shows the ecological concrete plant brick pavement in Kaiyuan temple, Quanzhou city in Fujian Province.

2.5The Impacts of porous pavement in controlling flood in urban area

Traditional impervious pavements collected rainwater by using the corresponding drainage pipeline, then these collected water was drained into urban drain pipe. This measure led to the increasing of surface runoff and pressure of urban drainage pipeline. It caused waterlogging in many cities because their drainage pipelines hadn't enough drain ability or had been artificial silted up. For example, when Beijing's control area ratio of drainage pipeline was 20%, impervious pavements area ratio was 20%, its flood peak was 1.5 times as original flood peak flow. When control area ratio of drainage pipeline was 60%, impervious pavements area ratio was 60%, then its flood peak was 3 times as original flood peak. This indicated that urban surface runoff increased rapidly

along with the increase of impervious pavement's area ,so flow of flood peak was added too, the serious consequence was leading flood disaster. Because of its own permeability, porous pavement can reduce the pressure of flood discharge. The surface runoff flows gently. The peak value of runoff is recede ,and its flux raise and reduce gently too. Undoubtedly , controlling flood in urban area can benefit from the porous pavement^[2].

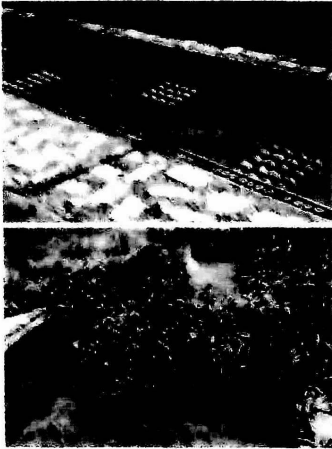


Fig.4 Ecological concrete balls can create a favorable environment for some aquatic animals and plants

2.6 The Impacts of porous pavement in cleansing of sewage

Depending on its own porous structure, the porous pavement in water can create a favorable environment for some aquatic animals and plants. These aquatic animals and plants can decontaminate the sewage in urban area^{[6][7]}. The ecological concrete balls create a favorable aquatic animals and plants environment to cleans the sewage. Fig.3 shows the special ecological concrete balls developed by material department of Southeast University . This special ecological concrete balls can be used to improve water quality of lake & river water just as Fig.4 shows . These applications testified that porous pavement had distinct advantages about cleansing of sewage^[8].

3. THE ADVICE AND COUNTERMEASURES FOR POROUS PAVEMENT'S RESEARCH

All in all, generalizing and applying porous pavement ,exerting the ecology environmental benefit, it is an important measure to improving urban ecology physical environment. Considering the present situation of research for porous pavement in our country and the experience abroad, some advice and countermeasures were also suggested.:

3.1 Quicken application step of porous pavement on the base of present research.

3.2 Further study the mechanism of combining porous pavement's application with utility of the rain-water.

3.3 Formulating the special urban planning and construction regulations about porous pavement..

3.4 The sustained porous structure must be satisfied in construction management and maintaining. Suggest to exploit and manufacture relevant equipments for cleaning porous pavement.

3.5 Developing the mechanism research of cleansing of sewage to protect water environment .

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