Various characteristics of cross-sectional repair materials using the New Latex

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Abstract. In Japan, as there is a large number of infrastructure constructed between 1955 and 1973, there will be continual deterioration over time. Due to partial rebuilding or repair of preventive maintenance, it is currently required to be in service for longer than the design useful life. From this background, the demand for repair materials such as polymer cement mortar is expected to increase further in the future, so we have developed a new Latex for polymer cement mortar for the development of new repair materials.

As a results, the new latex showed a tendency that the amount of decrease in compressive strength from the standard specimen was smaller than that of the commercial product. The water absorption rate was almost the same as that of the commercial product, but the water permeability was significantly reduced. Furthermore, it was found that the effect of latex addition on water absorption was smaller than that of commercial product A, and that the new latex was effective as a waterproofing agent in a small amount.

Keywords: polymer cement mortar, Latex, cross-sectional repair material.

1. Introduction

In Japan, there are about 700,000 road bridges and about 10,000 tunnels. In particular, many infrastructures were built between 1955 and 1973, and the number of infrastructures that have been in service for more than 50 years is increasing [1]. Since the service life of these infrastructure structures is 50 years, it can be said that a large amount of aging infrastructure is stocked.

On the other hand, there are some active bridges that have been in service for more than 80 years with appropriate repairs and reinforcements [2]. Due to partial rebuilding or repair of preventive maintenance, it is currently required to be in service for longer than the design useful life. From this background, the demand for repair materials such as polymer cement mortar (hereinafter referred to as PCM) is expected to increase further in the future, so we have developed a new Latex for polymer cement mortar for the development of new repair materials.

2. About of New Latex

It is generally said that the use of latex improves mass transfer resistance in mortar. Existing latex forms a polymer film by cross-linking the contained polymers with the dissipation of water [3]. The formed polymer film is stretched around the voids, complicating the mass transfer path. On the other hand, the core-shell polymer is used as the polymer of the new latex.
The core-shell polymer has a shell covering the surface of the polymer and has the effect of delaying film formation. In addition, by imparting an affinity with cement, it is possible to arrange the polymer particles in the void structure without bias.

3. Property of New Latex using Core-Shell Polymer

In order to confirm the performance of the new latex, a compressive strength test, a water absorption test, and a hydraulic conductivity test were conducted. The compressive strength test was based on IS 4031, the water absorption test was based on IS 4031, and the hydraulic conductivity test was based on IS 2645. The latex for comparison was three commercially available products that are widely used in India. Table.1 shows the PCM composition, Fig.1 shows the compressive strength test results, and Fig.2 shows the water absorption rate and permeability. The new latex showed a tendency that the amount of decrease in compressive strength from the standard specimen was smaller than that of the commercial product. The water absorption rate was almost the same as that of the commercial product, but the water permeability was significantly reduced. Furthermore, it was found that the effect of latex addition on water absorption was smaller than that of commercial product A, and that the new latex was effective as a waterproofing agent in a small amount.

Table 1. Mix proportions

W/C (%)	S/C	Weight value(g)			Remarks
		W	C	S	
40.6	3.0	81.2	200	600	Compressive strength test Water absorption test
98.0	3.0	294	300	1500	Plain's test piece of water percolation
70.0	3.0	210	300	1500	Latex 's test piece of water percolation
C：Ordinary Portland cement (Specific surface area 263m^2/kg, Density unknown) S：Fine aggregate (Density：2.57g/cm3，Water absorption rate：0.92%)					

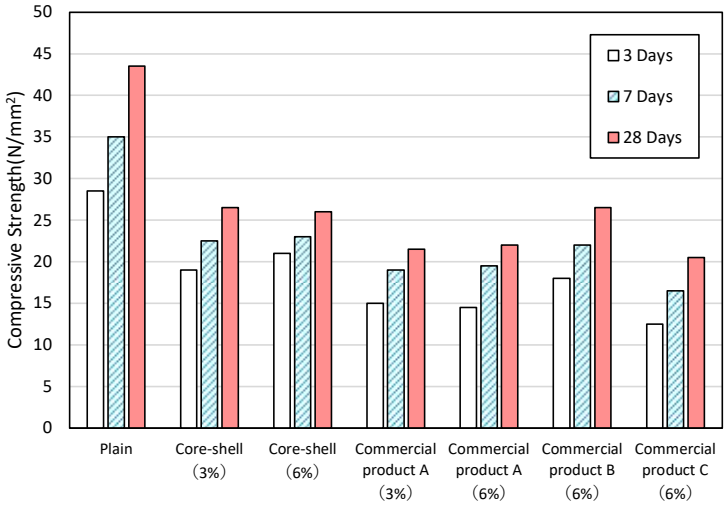


Fig.1. Compressive Strength

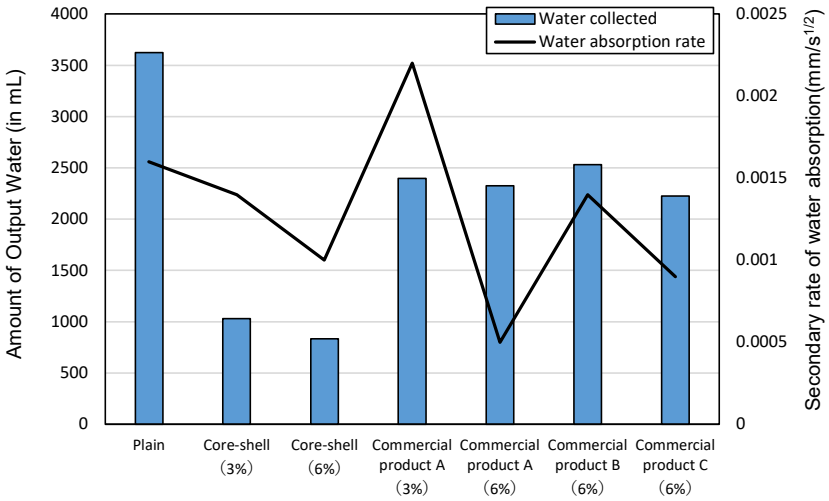
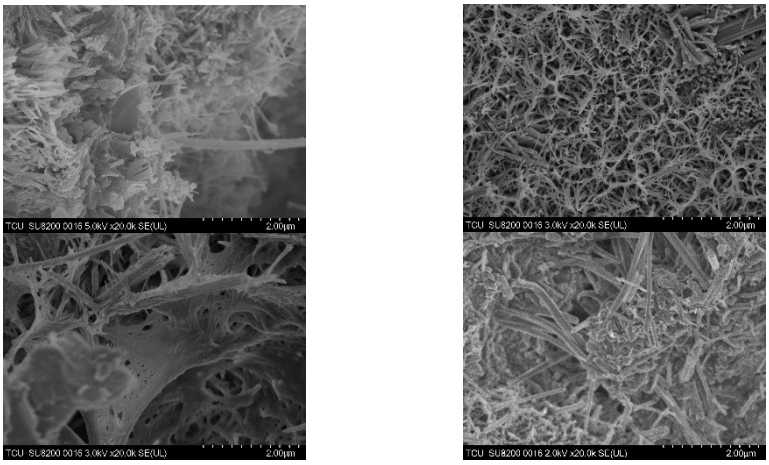


Fig.2. Water absorption velocity and through water

In general, there is a relationship between water absorption and permeability, but core-shell polymers have different tendencies. In order to verify the effect of the novel latex on water absorption and permeability, the state of the polymer was observed by secondary electron images. Photo.1 shows a secondary electron image (× 20,000). From our observation, we have found out that there is a difference in the polymer film being formed inside the void structure between new latex and commercial product. As of now, we don't know the mechanism, but the possible cause leading to the difference

in the polymer films, has some kind of effect concerning water absorption and permeability.



a) Commercial product b) New latex

Photo 1. Secondary electron image
(Upper side: Before water pressure, Under side: After water pressure)

4. Conclusion

We verified the performance of polymer cement mortar using a novel latex, which is a core-shell particle.

1) The compressive strength tended to be higher than that of commercial products.
2) The water absorption was almost the same as that of the commercial product, but the water permeability was significantly lower than that of the commercial product. The relationship between water absorption and permeability of the new latex is different from that of commercial products, suggesting that the mechanism of action is different.
3) It was found that the waterproof effect was exhibited with a lower addition rate than the commercially available product.

References

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