ICE-RETARDANT PAVEMENT

FINAL REPORT FOR

CITY OF DES MOINES

AND

IOWA DEPARTMENT OF TRANSPORTATION

HIGHWAY RESEARCH ADVISORY BOARD

RESEARCH PROJECT HR 290

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ABSTRACT

During 1986, the City of Des Moines placed on experimental asphaltic concrete overlay containing an ice-retardant additive (Verglimit) on Euclid Avenue (U.S. Highway 6). Verglimit is a chemical multi-component de-icer which is added to the surface course of an asphalt overlay. The additive was uniformly distributed through the mix at the asphalt plant, which allows exposure of the particles as the finished surface wears under traffic. During a snowfall, the exposed particles attract and absorb moisture creating a de-icing solution which dampens the pavement.

The Verglimit additive used on this project cost $1,180 per metric ton. The Verglimit was added at a rate of 6.3 percent by weight, which was 126 pounds per ton, or $66.38 per ton of hot mix asphalt. The purchase of Verglimit additive was funded by the Iowa Department of Transportation through a research project recommended by the Highway Research Advisory Board.

The pavement surface experienced severe wetting due to the additive's affinity for water immediately after the project was completed and during periods of high humidity. This wetting created slippery conditions both on the project itself and where vehicles tracked the additive. The only way to remove the slipperiness was by flushing the street with water.

The ice-retardant overlay appears to perform as expected in reducing the adherence of ice and snow, especially at temperatures just below freezing. It performs better in light snowfalls than in heavy ones. The ice-retardant overlay is effective in eliminating thin coatings of ice due to freezing drizzle or widespread frost. The accident data showed a reduction in the number of snow and ice related accidents but due to the low number of this type of accident the results are inconclusive.

INTRODUCTION

During August of 1986, the City of Des Moines placed an experimental asphaltic concrete overlay containing an ice-retardant additive on Euclid Avenue. This European-developed additive is marketed under the trade name Verglimit. Verglimit is a chemical multi-component de-icer which is added to the surface course of an asphalt overlay. It consists primarily of de-icing salts and caustic soda. The most common addition level is 5.5 to 6.5 percent by weight, which is adjusted according to the desired effectiveness, the traffic speed, the level of danger, the traffic volume, the altitude, and the length of the site.

The additive was added to the asphaltic concrete at the asphalt plant where it was uniformly distributed through the mix. This allows exposure of the particles to the atmosphere as the finished surface wears under traffic. As the pavement wears, the exposed particles dissolve by attracting and absorbing moisture from the air, creating minute pores in the pavement. The solution remains in the pore and continues to absorb moisture as humidity increases. During a snowfall, the pore becomes full and the solution will run out of the pore and damped the surrounding area. This solution on the roadway surface will make it difficult for the snow or ice to adhere. After a winter storm, as the humidity decreases, water in the solution evaporates, leaving the additive in the pore for the next storm.

LOCATION

The ice-retardant overlay was placed on Euclid Avenue (U.S. Highway 6) in Des Moines from First to Columbia Streets. This street is a 50 foot wide, four lane, undivided urban section, with one signalized intersection at Cornell Street. Euclid Avenue has a traffic count of 18,800 vehicles per day. Cornell Street has a traffic count of 5,500 vehicles per day. This location had received a 1 inch thick asphalt overlay during the previous construction season.

DESIGN

The 1,400 foot long, 1 inch thick overlay was estimated to require approximately 380 tons of hot mix asphalt. The recommended amount of Verglimit additive was 6 percent by weight, for a total of 22.8 tons of Verglimit. The maximum amount of Verglimit that could be shipped on one truck was 21.3 tons. Therefore, it was decided to allow a small portion of the project (25 tons of hot mix asphalt) to be completed without the Verglimit additive. A normal design for dense graded surface course mix was followed. The aggregate content in the 0 to 5 millimeter size range (#4 sieve) was reduced 6 percent by weight to compensate for the Verglimit addition. The optimum asphalt cement content was increased by 0.2 percent by weight. The recommended air voids for a Marshall design were 2.0 to 3.0 percent.

CONSTRUCTION

Asphalt Plant - The additive was added cold directly into the pug mill during the asphalt cement addition. The additive was emptied out of the sacks over a sieve with 3/4 inch x 3/4 inch openings to remove any chunks. If chunks of the additive exist in the mix, large pores and raveling could result in the finished product. The sacks were discarded and not thrown into the mix.

Placement - No significant differences were noted in placing the experimental asphalt overlay. "Feathering out" of the asphalt containing this additive is not allowed because raveling would more than likely occur.

Compaction - Compaction of the asphaltic concrete containing Verglimit should be performed with hot, dry rollers to prevent activation of the particles. A hot, dry roller was used on this project, but the asphalt began to stick to the drum. a small amount of diesel fuel was used to keep the asphalt from adhering to the roller, but this was considered detrimental to the asphalt and was discontinued. The only way to satisfactorily roll the mat was to use a small quantity of water on the roller. As long as the quantity of water was small and no water stood on the mat, it did not appear to activate the particles. Crushed sand was rolled into the surface with the last roller pass to enhance the skid resistance of the new overlay.

COST

The Verglimit additive used on the project cost $1,180 per metric ton (2,240 pounds). The Verglimit was added at a rate of 6.3 percent by weight, which is 126 pounds per ton, or $66.38 per ton of hot mix asphalt. The hot mix asphalt cost $25.00 per ton, for a total of $91.38 per ton of hot mix asphalt with the Verglimit additive. The purchase of the Verglimit additive was funded by the Iowa Department of Transportation through a research project recommended by the Highway Research Advisory Board.

ACCIDENT DATA

During the four year period prior to the placement of the ice-retardant overlay, the intersection of Euclid and Cornell experienced a total of 40 accidents with 4 of these accidents being snow and ice related (Table 1).

During the four year period following placement of the overlay, this intersection experienced a total of 42 accidents , with 2 of these accidents being snow and ice related. While the total number of accidents remained fairly constant, the number of snow and ice related accidents decreased from 4 prior to the overlay to 2 after the overlay. The comparative intersection of Army Post Road and SW 14th Street had an increase in the total number of accidents during this time period but had a decrease in the number of snow and ice related accidents. Due to the low number of snow and ice related accidents at these locations, it is difficult to draw any firm conclusions but it appears that the ice retardant overlay increased the safety of the intersection of Euclid and Cornell during snow and ice occurrences.

TABLE 1

	Euclid & Cornell		Army Post & SW 14th*	
Traffic Volume (veh/day)	18,800	5,500	20,000	5,800
1982-1985				
Total Accidents	40	(10/year)	60	(15/year)
Snow & Ice Related	4	(1/year)	6	(1.5/year)
1986	ICE-RETARDANT PAVEMENT PLACED			
1987				
Total Accidents	11		11	
Snow & Ice Related	0		0	
1988				
Total Accidents	12		19	
Snow & Ice Related	0		1	
1989				
Total Accidents	12		21	
Snow & Ice Related	2		4	
1990				
Total Accidents	7		21	
Snow & Ice Related	0		0	
1987-1990				
Total Accidents	42	(10.5/year)	72	(18/year)
Snow & Ice Related	2	(0.5/year)	5	(1.25/year)

*The intersection of Army Post Road and SW 14th Street was reconstructed during 1990 to add turning lanes on both streets.

EVALUATION

The pavement surface experienced severe wetting due to the additive's affinity for water immediately after the project was completed. This wetting created slippery conditions, both on the project itself and where vehicles tracked the additive. The additive was tracked up to eight blocks from the end of the project. The only way to remove the slipperiness was by flushing the street with water. This flushing was done twice a day for the first three days and once a day for the following week.

During the summer of 1987, a wet pavement surface occurred from high humidity on one occasion and the street was flushed with water. No wetting has been experienced since that time. The flushing that was done on this project may have decreased the de-icing potential of the overlay.

Prior to the construction of the ice-retardant overlay, the City felt that it may be able to reduce the application of de-icing chemicals on this section of roadway. Experience has shown that this is not possible. Due to the small size of the project and the small amount of de-icing brine produced by the ice-retardant overlay, normal amounts of de-icing chemicals have been applied to this roadway for all significant snow or ice occurrences.

The most significant benefit of this overlay has been the prevention of the initial formation of ice, enhancing the safety of this location.

A secondary benefit occurs during freezing drizzle or widespread frost accumulations which result in thin coatings of ice on the roadway surface. The ice-retardant overlay eliminated all ice on the roadway surface within the project and also tracked up to 12 blocks on Euclid Avenue, preventing the formation of ice on these streets also.

During the winter of '87-88, it was observed that the ice-retardant overlay seemed to be less effective than during the previous winter. Some ice did form on the roadway. It was felt that the pores in the surface had become partially obstructed by tire rubber. Therefore, the entire surface is thoroughly cleaned using a steel broom each fall prior to the snow season.

CONCLUSIONS

Based on our observations of the ice-retardant overlay, several conclusions can be made regarding this project:

1. The ice-retardant overlay appears to wear a well as a conventional overlay. However the low air void content in the mix design could cause bleeding of the asphalt and loss of stability.

2. The ice-retardant overlay appears to perform as expected in reducing adherenceof ice and snow, especially at temperatures just below freezing.

3. The ice-retardant overlay performs better in light snowfalls than in heavy snowfalls.

4. The ice-retardant overlay is effective in eliminating thin coatings of ice due to freezing drizzle or widespread frost.

5. The accident data for this intersection showed a decrease in the number of snow and ice related accidents after the placement of the ice-retardant overlay. Due to the low number of snow and ice related accidents it is difficult to draw any firm conclusions from this data, but the safety of the intersection during snow and ice occurrences appeared to increase.

6. An ice-retardant overlay can help reduce the potential for snow and ice related accidents prior to the application of normal de-icing chemicals, but cannot be used as an alternative to them.

7. Because of the high cost of the additive, it's use should be limited to specific areas that have a very high incidence of snow and ice related accidents.

8. Immediately after placement and during periods of high humidity, the additive can produce a wet pavement surface. This can create slippery conditions on the roadway surface.

9. Because of the problems with wetting of the pavement surface during periods of high humidity, the limited climatic conditions under which the ice-retardant overlay performs, it's limited deicing potential and it's high cost, it is doubtful the City of Des Moines would place anther ice-retardant overlay.