Investigation of the Ice-Retardant Characteristics of Verglimit-Modified Asphalt

JOHN M. RAINIERO

This project involved the design, application, and evaluation of an asphalt concrete mix, made ice retardant by the addition of encapsulated calcium chloride pellets (Verglimit). This deicing asphalt was placed along an 8/10-mi section of Route 173 in Clinton, New Jersey. The agent was effective in retarding icing of the pavement and made snow removal easier. Skid-resistance values taken over a 10-month period are as good as those of other Mix I-4 asphalt concrete pavements.

One of the hazards confronting motorists is slippery conditions caused by snow and ice. In an effort to investigate the potential of maintaining roadway safety during these conditions, the New Jersey Department of Transportation's Bureau of Maintenance has installed a deicing asphalt. The deicing material, Verglimit, derived from the French expression "limité le verglas" or "end slippery ice," was developed in Switzerland in 1973 and has been in use for ice control for 14 years in Europe, 10 in Canada, and 9 in the United States. This deicing material is essentially calcium chloride flakes, to which approximately 5 percent sodium hydroxide is added. The flakes are coated with linseed oil, which is polymerized to protect the flakes from water. This material is introduced into the asphalt concrete mix as part of the aggregates during the mix cycle. The treated mix is laid and compacted using conventional paving equipment. Thus, Verglimit flakes are exposed as traffic wears away the pavement surface. This abrasion should amount to approximately 1 mm per year, creating a continuous ice-free surface for the life of the overlay.

TEST SITE

A single test site was selected for the introduction of Verglimit. This site is located along an 8/10-mi section of Route 173 in the rural town of Clinton, New Jersey. This site receives an AADT of 5,000 and is situated in the northwestern part of the state, known as Region I (Figure 1). It is important to note that the AADT of 5,000 occurs during morning and evening rush hours; other times of the day, the AADT drops to 1,000 or less. The Route-173 site was selected because of the potential microclimate that would exist in a small area of roadway. There is a culvert, overhanging trees, a lake (acting as a solar collector), several side streets entering, and a stop light, creating various traffic conditions (Figure 2).

New Jersey Department of Transportation, Bureau of Maintenance, 1035 Parkway Avenue, E&O Building, CN600, Trenton, N.J. 08625.

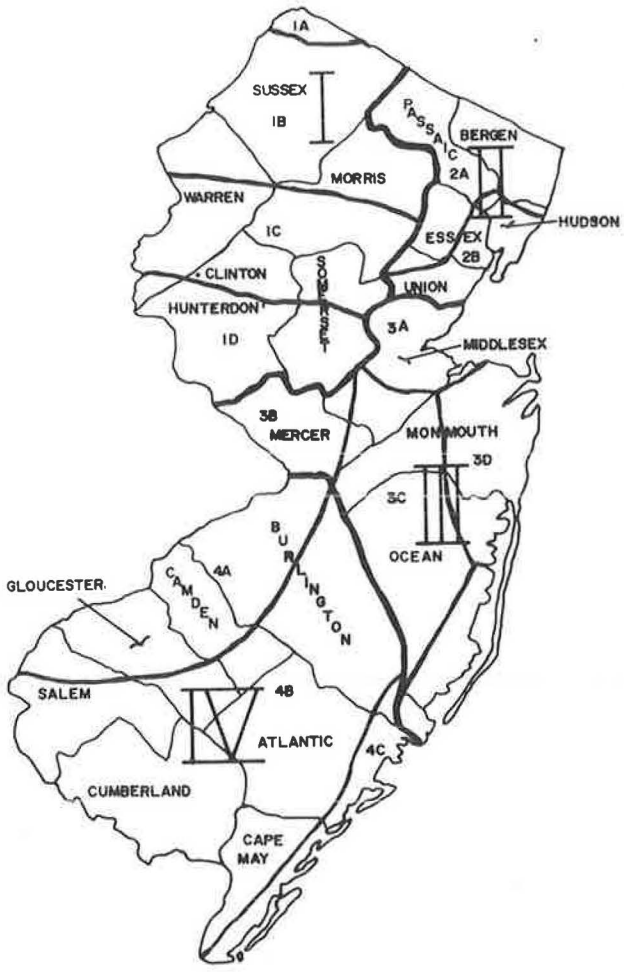

FIGURE 1 Weather map showing Clinton, New Jersey, test site.

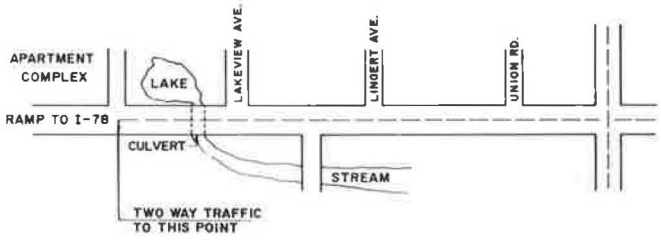

FIGURE 2 Section of Route 173 chosen for Verglimit testing.

MONITORING CRITERIA

1. At what temperature does Verglimit cease to be hygroscopic at the Route 173 test site?
2. How does snow accumulation affect the ice retardant pavement?
3. Does AADT affect the ice retardant pavement? If so, how?
4. What effect, if any, do changes in weather (i.e., rain to snow, or snow to rain) have on the deicing pavement?
5. What effect does the presence of a year-round deicing chemical have on appurtenances?
6. What are the monthly skid data?
7. How do sample cores taken periodically compare to original ones taken at the test site?

MIX DESIGN

The mix design chosen is shown in Tables 1 and 2.

MIX PREPARATION AT THE PLANT

Handling of Verglimit

It is important to handle Verglimit with care, so as not to crush the particles. The least amount of mixing necessary should be used in ensuring that all particles are totally coated with asphalt cement. To avoid undesirable absorption of moisture, the sacks of Verglimit should not be opened before they are placed in the mix. To eliminate occasional lumps, the sacks should be dumped over a sieve with openings of 3/4 in. × 3/4 in.

Protection of Personnel

Since Verglimit is an irritant, workers in direct contact with the Verglimit particles must wear goggles and gloves. Depending on other conditions, protective breathing masks should be considered. Contact with the skin must be avoided.

Verglimit Addition

Verglimit must be added continuously and loosely into the pug-mill. The apparatus for the addition must be constructed in such a way that each batch can be added in no less than 5 (to ensure homogeneous distribution in the mix) and no more than 10 (to avoid cracking) sec. If a batch mixer is used the following procedures have proven successful:

- Adding directly into the pug-mill through a hopper or via a conveyor belt. Whenever possible, Verglimit should be added in complete sack units only, which means that the batch weight must be adjusted accordingly. When using a hopper, a lock-gate is appropriate so that the hopper can be filled while the mixing process takes place.
- Adding directly over the filler scale. This method is favorable when there are two filler scales at the pug-mill. When using this process, it is particularly important to make sure that Verglimit is added gradually (minimum 5 sec) and is not exposed to the air for a long period of time.

Auger systems are to be avoided because they might lead to a considerable amount of cracking of the Verglimit particles. If they must be used, the auger should be no longer than 2.2 yards and should only be used for horizontal transportation. Under no circumstances should it be heated with the aggregate.

Time for Verglimit Addition

All aggregates, including the fines, must be in the pug-mill first. Then the addition of the asphalt cement is started. After a minimum of one-third of the asphalt cement is added, the Verglimit addition can be started; it should be finished at approximately the same time as the asphalt cement addition is completed.

Final Mixing Time

The mixing time, after all components including Verglimit have been added, should only be long enough for the Verglimit particles to be adequately coated with asphalt cement. This can be checked easily by looking at the mixed batch. No white particles should be visible after mixing. It has been found that the total mixing time usually remains unchanged from normal procedures. If the asphalt cement and Verglimit cannot be added at the same time because of plant constraints, the basic mix including the asphalt cement is mixed properly first. Then the Verglimit is added while the mixing continues. Once all the Verglimit is in the mix, the additional mixing time should not exceed 15 sec.

Mixing and Storage Temperatures

The mixing temperature depends on the type of asphalt cement. The respective norms must be observed. A mixing temperature of 329°F to 338°F should not be exceeded at any time in order to keep the mix from becoming like a mastic asphalt (bituminous mastic concrete) in character. This temperature also must not be exceeded if the mix is stored in heated or insulated silos. (It should be noted that the temperature in silos with a capacity above 50 tons can increase due to exothermic oxidation processes without any further heat being supplied to the mix from the outside.)

PLACEMENT OF THE OVERLAY

Supporting Pavement Surface

Surfaces being paved over must fulfill the usual requirements for smoothness, freedom from cracks, and impermeability. Wide cracks will reflect through (as they do when normal mixes are used) when a thin overlay of 1 to 1.5 in. thickness is applied. Therefore, the surface being paved over should be given a proper cleaning and preparation, or even a new profile if necessary. The supporting pavement surface must be dry and free of dirt and dust. The surface being paved over should be precoated with 10 oz to 1 lb/yd^2 of a suitable cationic emulsion or 5 to 10 oz/yd^2 of a water-free tack coat to obtain a proper bond between the old and new layers.

Weather

Verglimit surfaces should be placed in dry and warm weather only. The air temperature should not be lower than 50°F and

TABLE 1 MIX DESIGN

Mix: I-4 Verglimit
Producer: Trap Rock Industries, Inc. - Pennington, New Jersey
Type of Plant: Batch

Job Mix Formula

(Total Percent Passing Each Sieve)

Sieve Size	Verglimit Formula	Verglimit AVG. of 5
2"		
1 1/2"		
1"	100	100
3/4"	100	98 - 100
1/2"	93	88 - 98
3/8"	76	65 - 88
No. 4	52	35 - 65
No. 8	44.0	40.0 - 48.0
No. 16		
No. 30		
No. 50	16.0	13.0 - 19.0
No. 100		
No. 200	6.5	5.1 - 7.9
ASPH. CONT.	5.8	5.35- 6.25

*Percent Asphalt Cement Based on the Total Weight of Mixture

Bin Pulls

	PER CENT	APPARENT SPEC. GRAVITY	COMPONENTS - PRODUCER & LOCATION
Bin No. 5			
Bin No. 4	10.8	2.955	Trap Rock Ind., Inc.; Pennington, NJ
Bin No. 3	30.6	2.945	Trap Rock Ind., Inc.; Pennington, NJ
Bin No. 2	13.7	2.938	Trap Rock Ind., Inc.; Pennington, NJ
Bin No. 1	33.6	2.736	Trap Rock Ind., Inc.; Pennington, NJ
*VERGLIMIT ..	5.5		Verglimit -L & R Dist., Stanhope, NJ
Asphalt Cont. AC-20	5.8	1.025	West Bank Oil

Maximum Theoretical Specific Gravity: 2.597
Approximate Cold Feed Proportions: #67 Stone 30%,#8 Stone 25%, #10 Stone 39.5%, Verglimit 5.5%

Criteria - Original Mix Design

Stability - Lbs.	3010
Flow Value - 0.01"	16
Air Voids - Percent	2.7
VMA - Percent	16.8
Wt./Sq. Yd. Inch Thick	119

Mixture samples, Marshall Specimens and asphalt cement samples taken at Trap Rock Industries, Pennington, New Jersey. Tested at the plant and the Bureau of Materials Central Laboratory.

TABLE 1 *continued*

LOT PORTION	A	B	C	D	E	2 SAMPLES AVG.	2 SAMPLES RANGE	JOB MIX REQUIREMENTS FOR 2 SAMPLES MIN	MAX	RANGE
Date Sampled	9-23	9-23								
SIEVE SIZE PASSING						COMPOSITION ANALYSIS				
2" %	100									
1 1/2" %	100									
1" %	100	100						100		
3/4" %	100	100						98	100	
1/2" %	92	94						88	98	
3/8" %	83	86						65	88	
No. 4 %	56	57						35	65	
No. 8 %	40.5	39.5				40.0	1.0	37.5	50.5	13.0
No. 16 %										
No. 30 %										
No. 50 %	18.5	17.0				18.0		11.5	20.5	
No. 100 %										
No. 200 %	10.8	9.8				10.3	1.0	4.3	8.7	4.8
Asphalt %	5.75	5.75				5.75	-	5.10	6.50	1.5
TEST PROPERTY	MARSHALL TEST RESULTS							MIN.		MAX.
Stab. lbs.	3500	2050				2775		1000		
Flow, .01	18	13				16		6		16
Air Voids %	3.9	4.5				4.2				

PROJECT: ROUTE 173 - CLINTON, NJ TYPE OF MIX: I-4, VERGLIMIT

SAMPLE	1	2	3	4	5	6		
LOAD TEMP. (F)	280	285	285	280	285	290	AVE.	TARGET
SIEVE	% PASSING							
1"	100	100	100	100	100	100	100	100
3/4"	100	100	100	100	100	100	100	100
1/2"	94	95	95	90	87	92	92	93
3/8"	78	85	82	78	77	79	80	76
#4	52	59	55	54	52	51	54	52
#8	38.0	39.0	36.5	35.5	34.5	33.5	36.0	44.0
#50	14.5	16.0	15.0	15.0	16.0	14.0	15.0	16.0
#200	7.2	8.1	8.1	8.2	8.9	6.7	7.9	6.5
AC	5.85	6.00	5.85	5.65	5.70	5.60	5.80	5.8

MARSHALL SPECIMENS

Stability	2260	2220	2600	2370	2360	2460	2380
Flow	17	19	17	16	18	16	17
% Voids	2.2	3.2	2.8	3.0	2.4	3.5	2.8

NOTE: From Evaluation of I-4 Modified with Verglimit, E. Connolly, S. Seabridge, and J. Smith, unpublished data.
*See Table 2.

TABLE 2 PERCENT VERGLIMIT ADDITION

Average Speed of Vehicles Between 30-55 m.p.h.		
AADT Based on 2 Lane Roadway		
Number of Vehicles	Verglimit Addition	Minimum Number of Vehicles Per Lane
20,000 -	5.0%	10,000
5,000 - 19,999	5.5%	2,500
2,500 - 4,999	6.0%	1,250
1,000 - 2,499	6.5%	500
500 - 999	7.0%	250
100 - 499	7.5%	50
AADT Based on 4 Lane Roadway		
Number of Vehicles	Verglimit Addition	Minimum Number of Vehicles Per Lane
20,000 -	5.0%	5,000
7,000 - 19,999	5.5%	1,750
3,500 - 6,999	6.0%	875
875 - 3,499	6.5%	219
400 - 874	7.0%	100
100 - 399	7.5%	25
AADT Based on 6 Lane Roadway		
Number of Vehicles	Verglimit Addition	Minimum Number of Vehicles Per Lane
20,000 -	5.0%	3,333
10,000 - 19,999	5.5%	1,666
4,500 - 9,999	6.0%	750
1,000 - 4,499	6.5%	166
500 - 999	7.0%	83

*Percentages are based on 100% total weight of mix (e.g. aggregate + asphalt asphalt cement + Verglimit = 100%)

*Above 7.5% recommended only when used with a modified asphalt cement.

the supporting pavement surface should be dry. All placing should be avoided during rain.

Pavers

The same general conditions and specifications for placing a regular mix are applicable. Use only pavers with high precompaction screed capabilities operated at the highest compaction settings to obtain a smooth, closed surface. If there are still some porous spots visible behind the paver, they should be filled with some additional mix before the first roller passes. Inclines should always be paved uphill. If the width of the road varies, the use of pavers with hydraulically movable extensions is recommended.

Hand Work

Hand work must be kept to an absolute minimum and must be avoided in the wheelpaths. Porous areas and those being placed by hand must be sealed with a suitable emulsion-filler sealant before they are opened to traffic.

Longitudinal Joints

If possible, the whole width of the road should be placed in one pass with a single paver. Otherwise, two pavers should be operated in tandem to avoid cold longitudinal joints. When this is impossible, careful longitudinal joint compaction is necessary. If the longitudinal joint is placed cold (edge of first paver path—cold, new path—hot), the necessary uncompacted height of the mix has to be calculated (screed must be elevated sufficiently above the surface of the first paver path). A tack coat or infrared heating (or both) of the cold joint is required. (Alternatively, a melting joint tape can be used.) It is strongly recommended that the joint be sealed to a width of 6 in. the same day. This is mandatory if the joint is at all porous.

Construction Joints and Edges

Verglimit pavements must not be feathered down during construction. A full, sawn joint is required. The edges and the sawn joint must be clean and treated with tack coat. (If feathering must be adopted because of construction constraints, this must

be done with a regular mix.) The most suitable working method is to start and end placing with a plain mix (minimum of one truckload) and to continue with Verglimit mix without a transition. This way not only are the construction joints safe but an opportunity is provided to run the pneumatic-tired roller hot before it is operated (as the first roller) on the Verglimit mix.

Sealing of Critical Parts

All construction joints, contacts, porous parts, sides, and edges are to be sealed the same day to keep water from penetrating the surface. This will prevent potential ravelling of those areas.

Pavement Thickness

The thickness of a Verglimit pavement should at no point be less than 2.5 times the size of the coarsest aggregate.

Air Voids

Compaction of the mix is the governing performance factor for the pavement, in terms of stability and durability. (Suitable calibrated nuclear gauges can be used for overall compaction control.) The voids content of the pavement or drilled cores must under no circumstances exceed an average of 4 percent and an individual value of 5 percent.

A voids content between 3 and 4 percent should be the goal (while water can be used during core drilling, the use of special, denatured alcohol minimizes any water influences). For any Verglimit addition rate lower than 5.5 percent, the voids content of the pavement should not be much lower than 3 percent; otherwise the effectiveness during winter might be affected. On the other hand, the voids content of the pavement must not exceed 4 percent; otherwise water might penetrate into the pavement resulting in pavement damage. Local destruction always indicates an insufficient compaction.

Compaction Techniques

To avoid unwanted cooling of the mix, but more importantly, to keep water from penetrating the uncompacted surface, no water should be used on rollers (i.e., rolling should be hot and dry). If unavoidable, steel-wheeled rollers may be moistened but not wetted. Pneumatic-tired rollers should be driven dry; if absolutely necessary to avoid sticking, a very light oiling may be used.

Recommended Rollers

A pneumatic-tired roller (minimum of 2-ton wheel load; hot and dry) is recommended to obtain a quick closing of the surface. Next best is a steel-wheeled roller (minimum 12 tons). If a vibratory roller is used, the surface should be closed by a static steel-wheeled pneumatic-tired roller afterwards.

On-Site Placement of Overlay

With the test case, the average load temperature leaving the asphalt batch plant did not exceed 290°F. On-site temperatures were not recorded, but based on temperature versus time in transit measurements, the temperature of the mix at the paver was 275°F (using grand average) (Table 3) (*1*). The temperature range for Verglimit is 284°F to 338°F. In addition to this borderline temperature, there was a delay between the time of placement by the paver and compaction. Both of these contributed to the 7 percent voids, determined by cores taken at the job site (Table 4).

Verglimit should have between 3 and 4 percent voids. To improve skid resistance, angular concrete sand was rolled into the hot surface with the last roller pass (2 lb/yd^2), per manufacturer's suggestion. This was done to compensate for the slipperiness caused by the crushing of the calcium chloride pellets by the rollers during compaction, not the release of linseed oil. Additional sand was hand broadcast several times to soak up the "oil." This additional sand did not work well; in fact, it caused a roller-bearing effect. One accident—the only one on the Verglimit paved area—is attributed to this roller-bearing effect. It was found that flushing with water was the better method.

PERFORMANCE OF THE TEST SITE

Winter 1986–1987

In order to observe and control the amount of salt spreading of the test section, evaluators were present on site during all snow storms. The intent of Verglimit is not to terminate entirely the need to spread deicing chemicals. But because evaluators would be present during snow storms, spreading would not be allowed unless the integrity of safety was in question. Integrity of safety criterion was Verglimit failure (e.g., snow padding, vehicles sliding, etc.). Based on this decision, the test site was spread a total of 8 times, as compared to the 40 times for adjacent areas. Before each snow storm the presence of Verglimit on the surface was verified by the silver nitrate test; if silver nitrate was present, it would produce a blue color.

Since Verglimit is hygroscopic it is transformed immediately after its release into solution and adheres to the pores of the road surface. Once in solution it is distributed by passing traffic, creating a thin layer of solution on the roadway. This was evident during ice storms and light snow accumulations, when either the entire roadway was ice free, or in the case of light snow accumulations, the wheelpaths were clear. Snow pads (snow adhering to the surface) for the most part were nonexistent except when the AADT was low and snow accumulations heavy.

COST

To say that the Verglimit modified asphalt reduced labor, equipment, and material usage by 86.4 percent is misleading. Verglimit, in 1986, cost $101.00 per ton for materials. The Route-173 project took 846 tons for a cost of $85,446.00. The data in Table 5 indicate a savings of $647.00 for labor, equipment, and materials as compared to the control section. If the life of the Verglimit-modified asphalt pavement is 10 years, then viewed in terms of manpower, equipment, and materials savings, Verglimit is not cost-effective. Therefore, cost should not be the only consideration; reduction in ice- and snow-related accidents should be the principal reason for placement.

TABLE 3 RATING EFFECTIVENESS OF HOT MIX TARPS (*1*)

PLANT AND PAVER TEMPERATURES - 25 INDIVIDUAL TESTS								
			Tarped			Untarped		
Load (Tons)	Transit Time (Minutes)	Air Temp Degrees F.	Mix Temp Plant* Degrees F.	Mix Temp Paver Degrees F.	Paver Temp Mix Temp	Mix Temp Plant* Degrees F.	Mix Temp Paver Degrees F.	Paver Temp Mix Temp
Woodworth and Company, Inc.								
-	25	51**	345	310	89.8%	338	300	88.7%
14	30	50**	365	353	96.7	355	338	95.2
13	35	-	323	328	102.0	330	328	99.4
15	18	41	395	347	87.8	360	318	88.3
9	17	48	348	328	94.2	345	338	97.8
15	30	55	355	332	93.5	358	320	89.4
15	35	-	373	358	96.0	375	348	92.8
8.5	30	65	370	343	92.7	350	328	93.7
15	60	48	363	333	91.7	355	332	93.5
				Avg.	93.8			93.2
Michigan Dept. Highways and Transportation								
40-15	20	48	300	298	99.3	300	298	99.3
55	45	55	310	303	97.7	310	303	97.7
21	50	42	350	338	96.6	350	315	90.0
-	40	34	350	348	99.4	350	340	97.1
-	30	40	348	348	100.0	348	345	99.1
				Avg.	98.6			96.6
Central Paving Company								
15	60	51	320	288	90.0	315	288	91.4
15	60	57	273	220	80.6	260	208	80.0
15	60	51	323	303	93.8	345	300	86.9
15	60	54	340	300	88.2	330	290	87.9
26-30	45	48	310	297	95.8	310	293	94.5
36	58	53	283	275	97.2	320	308	96.2
26-30	45	55	305	285	93.4	298	288	96.6
32	45	68	320	300	93.8	313	290	93.5
26-30	60	73	290	270	93.1	298	272	91.2
30	65	38	345	338	98.0	348	307	88.2
30	65	34	323	295	91.3	353	315	89.2
				Avg.	92.3			90.5
				***GRAND AVG.	94.9			93.4

* Average Temperature 4" Below Surface of Truck Load
** Rain
*** Used Grand Average

Verglimit has other positive benefits. Because there is a reduction in manpower usage (Figure 3), other problem areas can be covered, thus further reducing possible accidents caused by ice and snow.

SKID DATA

Skid resistance values were determined (in accordance with ASTM E274) the day after placement and are on a monthly monitoring schedule. These values indicate that the Verglimit added asphalt is as good as other Mix I-4 areas (Figure 4).

DISCUSSION OF RESULTS

Visual inspections indicate that Verglimit, during the first winter of operation, performed as indicated by the manufacturer. There was a reduction of icing during ice storms, and in light snow accumulations, the wheelpaths were clear. In heavier accumulations the wheelpaths were mealy in appearance and snow did not adhere to the pavement. Nonadherence to the pavement was true except when conditions of rain to snow existed. This condition has a tendency to flush the surface, causing temporary padding. This is temporary because Verglimit in solution is present in the pores of the roadway and is redistributed by the action of rolling tires. The fact that the

TABLE 4 PERCENT VOIDS

ROUTE 173 MAINTENANCE CONTRACT A-70895 I-4 MODIFIED WITH 5.5% VERGLIMIT

PRODUCER (A) TRAP ROCK IND.-PENNINGTON, NJ ICE RETARDANT ASPHALT CONCRETE

DATE COMPLETED: MIX NO. I-4 MIX NO.

CORE NO.	LOCATION (POLE)	STATION W.O.S	LANE	OFF SET	DATE CUT	THICK-NESS	BULK SP.GR.	S.I.	AIR 2&3 VOIDS %
1	209	610'	R	9'	10-9-86	2.0"	2.347	2.587	9.3
2	214	1025'	R	6'	10-9-86	1.2"	2.457	2.597	5.4
3	415	1743'	R	8'	10-9-86	1.6"	2.335	2.547	8.3
4	419	1607'	L	5'	10-9-86	1.7"	2.364	2.555	7.5
5	217	1175'	L	4'	10-9-86	1.3"	2.454	2.578	4.8
						B5=			
6	244	531	L	5'	10-9-86	1.8"	2.411	2.604	7.4
						% VOID		AVERAGE	7.1

TABLE 5 COMPARISON OF COSTS OF SPREADING DEICING CHEMICALS

Verglimit (Mix Mod. I-4)	Control Section (Mix I-4)
Labor and Equipment $33.00 Per Hour $ 8.25 Per 15 Minutes	Labor and Equipment $33.00 Per Hour $ 8.25 Per 15 Minutes
Materials (Salt) $30.00 Per Ton $ .015 Per Lb.	Materials (Salt) $30.00 Per Ton $ .015 Per Lb.
Spread Rate (Material): 150 Lbs. Per Lane Mile 2 Lane Miles = 300 Lbs. of Material	Spread Rate (Material): 350 Lbs. Per Lane Mile 2 Lane Miles = 700 Lbs. of Material
Cost: $ 4.50 in Materials Per Spread $12.75 Per Spread (Labor, Equipment & Materials) For 2 Lanes - $12.75 (8 Spread) = $102.00	Cost: $10.50 in Materials Per Spread $18.75 Per Spread (Labor, Equipment & Materials) For 2 Lanes - $18.75 (40 Spreads) = $749.60
SAVINGS: $647.60 (1986-87 Snow Season) 86.4% Reduction in Cost	
NOTE: Time to Spread 2 Lane Miles: 15 Minutes	

solution tends to stay in the pores can be explained by the specific gravity of the solution, which comes to 1.3 in contrast to 1 for water. Padding also occurred when the AADT became low, but as the AADT increased, traffic broke up this padding. When snow accumulation is light, the AADT can be low and Verglimit will be effective. As the storm intensifies, the AADT must increase. Verglimit requires a minimum of 5,000 AADT to release the additive properly and knead any frozen precipitation on the pavement. On the Route-173 site the necessary AADT occurred during the morning and evening rush hours; other times of the day the AADT dropped to 1,000 or less. If a storm arrived in between the rush hours, spreading became necessary.

CONCLUSIONS AND RECOMMENDATIONS

- Since Verglimit is hygroscopic, problems with effectiveness occur at or below 27°F. On occasion, ambient

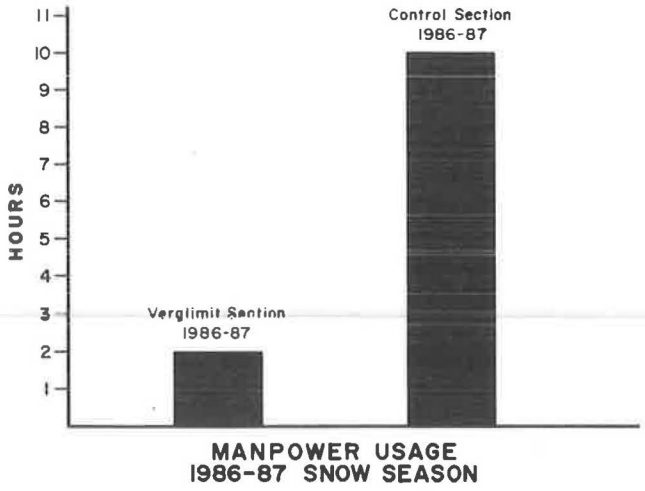

FIGURE 3 Comparison of manpower/equipment usage in spreading operations, 1986–1987 snow season.

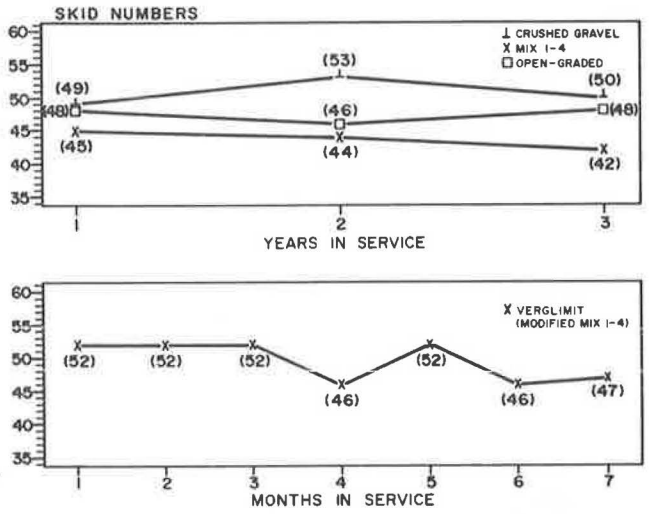

FIGURE 4 Comparison of skid data [average skid number (SN40)].

temperature dropped to 24°F and still functioned. This may have occurred because a brine solution existed on the surface. Another factor was depth of snow (accumulation). Provided there was sufficient AADT, wheelpaths were clear with accumulation up to 1 in. Again, with sufficient AADT, wheelpaths were mealy (offered good traction) in accumulations up to 2 in. It was advantageous to plow at this point, thus reducing the depth of snow on the roadway surface and allowing vehicles to redistribute the Verglimit additive and knead frozen precipitation on the pavement.

- Skid resistance is as good as other Mix I-4 areas (Figure 4).
- Verglimit overlays should be placed in dry and warm weather only. Before paving, the roadway should be dry; placement during rain should be avoided.
- During compaction, the Verglimit flakes at the surface are broken. Since they are hygroscopic, they tend to expand and, along with the linseed oil, create a potentially slippery condition. Skid testing was not done at this point, but on-site evaluation indicates a possible problem. After flushing with water, skid data taken the day after placement show excellent results (average 50).

At this time, any environmental problems associated by flushing have not been evaluated. According to the producer, however, only 0.5 g/m^2/day is released. This small amount should not pose a problem. Future test sites will be monitored to address this question.

- Angular sand should be rolled into the hot surface with the last roller pass (2 lb/yd^2), and not hand broadcast after compaction. In addition, the pavement should be flushed with water for several days after placement.
- Mixing and placing temperature range is 284°F to 338°F. Because batch plant tests indicate temperatures to 290°F leaving the plant, arrival on the job site 30 minutes later suggests a borderline temperature range placement (Table 3). This may have contributed to the 7 percent voids (Table 4). Verglimit should be in the 3 to 4 percent void range.
- Future monitoring should include
  - Skid testing immediately after compaction, to see if observations of a potentially slippery condition are true (on new installations of Verglimit). Continue to skid test every month.
  - Measuring the ambient temperature to determine the temperature at which Verglimit ceases to be hygroscopic.
  - Measuring snow accumulation to determine how it affects road conditions.
  - Checking AADT on nonpeak hours.
  - Taking core samples to check voids and thickness and comparing with initial samples.
- Though the Verglimit paved area initially received adverse publicity of traffic accidents, after placement only one accident occurred on the Verglimit paved area. This accident may have been caused by the sand which was broadcasted to prevent accidents but acted as rollers instead.
- A Verglimit modified asphalt overlay should not be restricted to the bridge deck parameters; it should be extended to the approaches or beyond. This will eliminate tracking of conventional deicing chemicals onto the deck.
- The placement of Verglimit on bridge decks should reduce corrosion since salting is minimized. Verglimit itself is released at a rate of 0.5 g/m^2/day. Future test sites should include bridge decks to determine if this is true.
- Durability of the pavement is excellent to date, but this pavement has 7 percent voids and is less than 1 year old. Because there is a full-time presence of chloride, the effect on appurtenances, if any, will be monitored.

SUMMARY

Because of the cost, Verglimit is not meant to be used to keep hundreds of miles of roadway free of ice and snow; nor is it meant to replace the regular ice control material, but rather to supplement it. Verglimit should be placed in points of danger, where ice and snow conditions cause accidents. These areas are usually a result of a combination of geographic and climatic conditions (places where there are structures, forested areas, swampy areas, river and stream valleys, steep inclines and declines, mountain cuts, etc.). It should be kept in mind that Verglimit is a continuous ice control; it prevents ice-ups,

thereby buying time to respond to call-outs, and to concentrate on other sections of snow-covered roadways.

ACKNOWLEDGMENTS

The author would like to express appreciation to individuals of the New Jersey Department of Transportation who participated in this investigation: John Pezik and Patricia Bowker of the Bureau of Maintenance, Charles Melillo of Region I Maintenance, Joseph Smith of the Bureau of Materials, Bridge and Maintenance Crews of the Clinton Maintenance Facility, Region III Materials personnel, and the Bureau of Maintenance's Pavement Management Section.

REFERENCE

1. Carl E. Minor. Are Hot Mix Tarps Effective? *Information Series 77*, National Asphalt Pavement Association, Riverdale, Md., pp. 3–5.