WASTE LATEX PAINT RE-USE PROJECT

THE WASTE DIVERSION ORGANIZATION AND THE CITY OF LONDON

Final Report - June 22, 2001

EXECUTIVE SUMMARY

This study was funded by the Waste Diversion Organization (WDO) to further develop viable construction products which will benefit from the addition of waste latex paint collected by municipalities at Household Special Waste Facilities.

This study is focused on discovering if a suitable re-use option is available, and if municipalities could capitalize on the opportunity to improve one or more of their standard construction elements, and save cost as well. Presently, it is estimated that over 750 tonnes of waste latex paint is collected and disposed annually in Ontario as special waste, at a cost of over $200,000. The objective is to find municipal products in asphalt or concrete, which will be enhanced by the addition of the paint, and reduce the cost of disposal.

The study included inputs from the paint industry, represented by Para Paints, and Kel Coatings, the asphalt industry, represented by Ashwarren Engineering Services, the concrete industry represented by Blue Circle Materials, and the University of Western Ontario, and project direction, air quality assessments, and technical input from the City of London and Earth Tech Canada.

Three areas of investigation and development were pursued including testing of the collected waste latex paint, research into asphalt mixes and handling, and research into concrete mixes and handling.

Waste latex paint collected in London during the study period was sampled and tested for the percentage of some of its basic physical components. Testing showed considerable variation batch to batch, which led researchers to recommend storing and mixing waste latex paint in large containers to average out the effects of the variations. This area needs ongoing testing, and further confirmation of the sensitivity of the receiving materials to these variations. Related testing in both the concrete and asphalt programs identified trace components in the paint which have significant effects on the suitability of waste latex

paint to be used in concrete and asphalt products. Testing for one of these components was undertaken. Others need to be tested and analysed.

Work in the asphalt research program was most disappointing. The earlier asphalt research had very positive results and a trial pavement had been constructed. This program intended to refine the pavement mix design and identify a suitable standard pavement product for municipal work. However, the reports from the trial pavement indicated an unpleasant odour had been emitted from the waste latex paint modified asphalt. A review of the components of typical latex paint indicated that a small percentage of ethylene glycol is included in the paint. (Samples subsequently tested set this at about 1% by mass.) Air quality experts analysed the asphalt plant, trucking and paving procedures and concluded that the current method of asphalt manufacture incorporating waste latex paint had the potential to cause the release of ethylene glycol vapour in concentrations beyond the recommended levels for protection of occupational health and safety. Ashwarren Engineering indicated that they could not continue to support this program unless a method of removal of the ethylene glycol was found. Calculations and an experiment were made to assess a method for the removal. The results were negative. There was no place within the asphalt plant where the ethylene glycol could be economically stripped from the asphalt. Thus the asphalt program was terminated.

The concrete program is not as developed as the asphalt program had been, and has only progressed part way towards developing products. Results are preliminary but hopeful. While previous research had focused on high end, latex modified concrete overlays, the team assessed that a more appropriate market would be concrete for sidewalk and curb and gutter work. These products were selected for three reasons; this is a common well understood product that is less sensitive to variations in mix components, there is a large annual market for this product, and there had been some success with the trial sidewalk and curb placements undertaken by the City. The trial placement showed significant aesthetic improvements for the sidewalk in colour, due to the paint pigments, and surface quality in the sharpness of the detail. The trial sidewalk included a portion of impressed concrete finish which emphasized the concrete’s ability to show fine detail.

Concrete research showed variable results. Waste paint substitutions of up to 60% of the mix water were tested. Tests with increasing amounts of waste latex paint showed adverse changes in the concrete’s handling, setting and air entraining characteristics. In-test modifications identified methods for partial compensation for some of these effects, but further research will be needed to define the impacts and develop modifications.

The City of London advised that they collect between 15,000 and 20,000 litres of waste latex paint each year. Including this amount of waste latex paint in sidewalk and curb and gutter concrete would provide enough concrete to construct new sidewalks, and curbs and gutters for approximately 1 to 5 kilometers of new roadway each year (depending on the rate of inclusion). The City of London assessed that this was a manageable amount of new work, within their normal scope of annual construction.

1. INTRODUCTION

This report describes the work undertaken to progress the scientific, engineering and practical bases of adding waste latex paint, collected at Municipal Household Special Waste (HSW) Depots into construction products used by municipalities. The project was planned in five steps, and separately in each of the asphalt, concrete, and collected paint industries.

The following data provide some background information on waste latex paint quantities that help put the importance of this work into context:

- There were 6,364 tonnes of HSW collected in the Province of Ontario 1999 (WDO 1999 Fact Sheet)
- 21.7% of the HSW was waste paint (WDO 1999 Fact Sheet)
- Approximately 12% or 763 tonnes was waste latex paint (assuming slightly more than half the paint is latex)
- This is equivalent to approximately 500,000 litres of waste latex paint (assumed density of paint is 1.5 tonne/m3)
- It is projected that the 500,000 litres/year waste latex paint figure will increase in the future for the following reasons:
    - Waste composition studies indicate that current HSW Management Programs only result in the collection of 10% to 30% of the total HSW that is generated. Further Public Education efforts could raise participation and capture substantially;
    - The use of latex paint relative to alkyd (oil) paint has, and will continue to increase.
- The 500,000 litres, currently estimated, would produce 18,000 m3 of concrete assuming a ~20% replacement of water with paint (~28 litres of paint per m3 of concrete)
- This is enough concrete to make 96 kilometres of sidewalk (each m3 of concrete will make 5.3 metres of sidewalk 1.5 metres wide by 0.125 metres deep)
- London collected 20,000 litres of latex paint in 1999
- This will produce 710 m3 of concrete which is enough concrete to make 3.8 kilometres of sidewalk

Background Information on Costs

- The cost for disposal of bulk waste latex paint under The City of London's current contract is $95 per 205 litre drum or $0.46 per litre.
- The cost to ship paint in the original cans (not bulked) is approximately $350 per skid. Each skid holds 125 – 4 litre cans. Therefore the disposal cost varies from approximately $1.40 per litre (assuming typical can is ½ full) to $0.90 per litre (assuming typical can is 3/4 full).
- Assuming all 500,000 litres of waste latex paint in Ontario was bulked, the current total cost for disposal would be approximately $230,000 annually.
- Assuming half of the 500,000 litres of waste latex paint in Ontario was bulked, and the other half was shipped on skids, the current total cost for disposal would be approximately $400,000 annually.

2. BACKGROUND

This project follows earlier research into the addition of waste latex paint into concrete and asphalt products. Ryerson University undertook studies on hot mix asphalt mixes and latex modified concretes. Results showed improvements in laboratory hot mix asphalt mix stabilities, and in the permeability of concrete. Test results in asphalt were consistently positive. Test results in concrete showed variability in the changes to the basic properties of concrete. Field trials were conducted by the City of London at their Household Special Wastes Depot. The resulting work showed positive benefits. The team for this study viewed these works and their observations are highlighted below.

3. PROJECT OBJECTIVES

This project was established by the Waste Diversion Organization in conjunction with the City of London, the paint and coatings industry, the asphalt industry, and the concrete industry, to further develop the opportunities to use waste latex paint in construction products in the asphalt and concrete sectors. It is anticipated that, developing a use for waste latex paint will provide a major diversion from waste products into useful products, and although adding handling costs, will greatly reduce municipalities' waste disposal costs, and hence their total costs.

This study is focused on discovering if a suitable re-use option for waste latex paint is available, and if municipalities could capitalize on the opportunity to improve one or more of their standard construction elements, and save cost as well.

The objectives of this program were generally to develop viable commercial products in each of the asphalt and concrete industries.

4. PROGRAM

Earlier studies sponsored by the paint industry and undertaken by Ryerson Polytechnic Institute had identified both concrete and asphalt products that could be improved with the addition of waste latex paint. These were initial research studies, which calculated the impacts of waste paint additions. Some limited, bench-scale testing supported these calculations. It was the conclusion of this work that the concept of waste latex paint being used in partial substitution for water and latex polymers in pavement materials manufacture was possible and that investigations involving actual commercial materials and field trials should be conducted. In support of this earlier, promising work, this current Waste Latex Paint Re-use Project was established.

This program included five activities: developing further technical data; establishing target markets and products; establishing equipment modifications to utilize waste latex paint in these products; working with the industry and regulators to develop standard guidelines for these products; and communicating with the industries, regulators, and interest groups.

Work proceeded in two product areas: asphalt; and concrete. The asphalt industry identified their target market as hot mix paving with recycled aggregate, while the concrete industry focused on sidewalks and curb and gutter work. Both industries had provided similar sample products in November 1999, as demonstration projects at the London Landfill HSW Facility.

5. PROJECT TEAM

A team of experts was assembled to examine the opportunity to include waste latex paint in hot mix asphalt paving and concrete sidewalks and curbs.

The team was led by Wes Abbott P. Eng. of The City of London’s Solid Waste Management Department and included Paul Lum P. Eng of Ashwarren Engineering Services (AES), representatives of the Asphalt Paving Industry; Mike Pratt of Blue Circle Materials (BCM), representatives of the Concrete Ready Mix Industry; Don Warren of Para Paints, providing input from the Ontario Paint Industry Association (OPA); Dr Moncef Nehdi P. Eng. of the University of Western Ontario, providing specialist research into concrete testing; and Doug Whitney P. Eng., Jean-Yves Urbain P. Eng., and Michael Pratt of Earth Tech Canada Inc (ETC), providing engineering overview, air quality assessments, and project guidance.

6. WASTE LATEX PAINT COLLECTION AND TESTING

The City of London accepts waste paint from City residents at its Household Special Waste Depot on Saturdays. This paint, which is the left over remains of the homeowners' decorating, is received in 1 and 4 litre cans. City staff sort the paint by type, and open and empty the waste latex paint into 205 litre drums. Records indicate that the City has collected between 15,000, and 20,000 litres each year.

The paint in the drums was sampled and tested in this program. From December 2000, to March 2001, the City sampled nine drums. Samples were taken by City staff, and sent to Kel Coatings who volunteered their time to undertake some basic physical determinations. Tests included density and percent solids. Based on these results, calculations were performed for percentage of water, latex, titanium oxide and fillers. Additionally, the City sent samples to Philip's laboratory for testing of the percentage of ethylene glycol. Test results are reported in the appended table.

Tests show variability between the 9 drums collected through the winter collection days.

- Density was consistent (1378 to 1528 kg/cu. m), ie: within 5% of the mean,
- Solids content varied significantly (35.8% to 47.2%), ie: by up to 16% from the mean, hence water content varied by a similar 18% from the mean
- Ethylene glycol content varied significantly (0.8% to 1.4%) ie: by up to 29% from the mean.
- TiO_2 (white pigment) and extender pigments each were variable as expected, (9.4 to 15.5%) varying 25% from their mean
- Latex content varied significantly, (12.9 to 18.1%) varying 18% from the mean
- This program did not assess surfactants, which have been identified as significant for their effects on concrete.

These types of variations are to be expected from a waste diversion product. It can also be observed that combining these 9 drums would create a single volume with 1,845 litres of blended waste latex paint, which would reduce these variations of 5 to 30%. This improved consistency would improve the usefulness of the re-useable product immensely. As noted later, this would suit the receiving industries from both the production and QA/QC perspectives.

As the addition of waste latex paint affects the mixes using these products, these variations may further affect the properties of these mixes. Thus the variations affect the ability of the receiving industries to proportion their mixes exactly. This, in turn supports the concept of lower batching percentages, for which the variations then would have lower effects on the mixes.

7. ASPHALT PROGRAM

In this program, asphalt research was planned to refine the proportions of the mix tested earlier and used at the demonstration project, and to better define the benefits of the waste latex paint as an additive to hot mix asphalt paving. However, an issue arose at the trial paving that needed to be addressed prior to refining the mix proportions.

At the trial paving, the paving crews complained of an offensive odour coming from the asphalt, causing discomfort. Ashwarren Engineering Services, together with Earth Tech's Air Quality expert, Jean-Yves Urbain, considered the problem. It was felt that the odour was similar to that of automotive antifreeze, which is primarily ethylene glycol. An examination of the typical composition of latex paint provided to the team by the paint industry through Don Warren, identified that the waste latex paint would likely have a small percentage of ethylene glycol, among other coalescent solvents. Thus an assumption that ethylene glycol could have been the source was made and assessments were begun to evaluate effects on that basis. It was calculated that, depending on the assumed content, temperature, and handling effects, that it was possible that the exposure to the crew members could have exceeded recommended levels. Thus this was confirmed as a potential health and safety issue. Ashwarren Engineering stated that they needed a solution if they were to continue to pursue the use of latex paint in hot-mix asphalt.

Typical hot mix is prepared at 180 ^{0} C. The ethylene glycol begins to be stripped at about 115^{0} C. This results in most of the ethylene glycol having the potential to be stripped due to the elevated temperature of the hot mix. However, the stripping cannot occur until the coated aggregates are close to the surface of the asphalt, which occurs for a only few seconds, in a few places in the plant, only slightly during trucking, and then more rapidly during spreading and rolling. Thus in a normal paving project, most of the offgassing would likely occur as the pavement was spread.

Jean-Yves calculated how best the ethylene glycol might be stripped from the hot mixed asphalt in the plant, without having to modify the plant too much. The best opportunity for stripping occurs in the mixer, where the coated aggregate is tumbled, bringing it to the surface where contact with added, heated air can be achieved. Calculation showed that it would take a 200,000 cfm stream of 200^{0} C hot air for 30 seconds into the mixer to strip enough ethylene glycol to realize the benefit needed. While this may be possible, Paul Lum assessed that it would not be practical to modify the mixer to accept this airflow. Thus another opportunity needed to be found.

The only other place where the coated aggregate could be readily exposed to a hot air stream to be stripped of the ethylene glycol is in the plant’s bucket elevator. The elevator carries the aggregates, which have the paint coating on them, up the tower to the hopper before the mixer. Here, a hot air stream could be introduced at the bottom and extracted at the top with little modification to the equipment. The travel time in the bucket elevator is only seconds and thus a large airflow would be needed. This application would not be as effective as an application at the mixer, because the aggregate would be held in buckets, instead of being tumbled in the mixer, where each particle would get direct contact with the air stream.

A test was devised and run to simulate the bucket elevator environment. As reported in the attached appendix, the test showed that the ethylene glycol could not be stripped effectively in the bucket elevator environment. It was concluded that only with major plant modifications could a system be installed to achieve the required stripping.

The asphalt industry decided that this problem was insurmountable in an economic manner and thus that they could no longer participate in developing a waste latex paint modified hot mix product.

Consideration was also made of using waste latex paint in cold mix asphalt products. Ashwarren explained that the chemistry of cold mix asphalt emulsions is quite complex. Their chemists were not satisfied the waste latex paint could be adequately controlled to maintain quality control of their emulsions. Thus they were not interested in developing cold mix products which included waste latex paint.

Thus the planned product refinement testing was cancelled and the asphalt program stopped.

8. CONCRETE INDUSTRY

Previous research in concrete materials had focused on capitalizing on the waterproofing characteristics of the latex in the paint. While there is a small market for latex modified concrete overlays for bridges, it is both an uncommon practice and a highly specialized one. The concrete industry had expressed concern that this difficult product and construction environment would be too challenging for a waste diversion project.

Juxtaposed with this high tech latex modified research, was London's trial placement of sidewalk and curb with waste latex paint used in lieu of part of the mixing water. These demonstrations were inspected by the team at the beginning of this study, and were seen to be significantly superior to common sidewalks in colour and surface features.

Based on the previous studies and trial concrete placements, the team quickly decided that a medium complexity application in concrete was more suitable than a high-tech latex modified overly application. It was agreed that sidewalk and curb and gutter concrete met these criteria. The field trial sidewalk and curb and gutter concrete showed excellent results. Thus the team decided to focus concrete development efforts on these products.

Professor Nehdi of the University of Western Ontario, prepared a work program for a study to begin testing the impacts of various percentages of waste latex paint in the concrete mix. Budget constraints limited the study scope to basic measurements, with the expectation that this study would lay the groundwork for a future study to develop more refinements in the mix design.

Blue Circle Materials provided their standard OPSS sidewalk and curb mix design "recipes" and materials to Professor Nehdi for testing. The City of London provided samples of their collected waste latex paint from two different drums for testing. Seven different mixes were tested, including percentages of waste latex paint varying from 0% (control mix), to 60% replacement of the mix water in, 10% increments.

All of the tests provided information that is useful and will help to define the best way to incorporate waste latex paint into concrete sidewalk and curb and gutter mixes. Results varied considerably and in their variability provided new insights into the effects of including the waste latex paint. The study report is appended. Professor Nehdi provided four conclusions and eight recommendations.

Three of the conclusions identified the potential for positive improvement effects noted in the test program, all of which require further testing to focus on the effect and capture the benefit, and the fourth conclusion noted a disadvantage, which seems manageable, but has not been investigated at all yet.

These conclusions were:

> That the waste latex paint could reduce the dosage of air entraining agents required. This may reduce costs. The effect needs to be quantified to ensure quality control of the mix.
>
> That the waste latex paint could reduce or eliminate the dosage of water reducing agents. This may reduce costs. The effect needs to be quantified to ensure quality control of the mix.

That the waste latex paint delays the setting time. This could be a disadvantage. The effect needs to be quantified to ensure quality control.

That the waste latex paint can refine the porosity. This is an advantage. The effect needs to be quantified to demonstrate the benefit.

While most of the components of the waste latex paint seem compatible with, and beneficial to concrete, from this study we assess that two components have the potential to disrupt the normal regime of batching, handling, placing and curing concrete for successful sidewalk and curb and gutter work. These components are the surfactants, and the fillers. The study noted major effects of the surfactants on air entrainment, water reduction, slump and setting time. These were adverse affects that need to be controlled. Professor Nehdi made some adjustments as the tests progressed that partially controlled the effects in the later part of the testing program, but the chemicals contributing the effects and the methods of adjustment need to be explored much more intensely in a future study. If properly controlled, some effects may reduce the cost of the mix, while others may require the addition of compensating admixtures, which may increase the cost. All affect the basic quality of the concrete and need to be well understood, with an appropriate method of control developed, in order to provide a basic level of quality control and consistency for the supplier and end user/purchaser.

The first recommendation deals with the storage and handling of the waste latex paint to improve the consistency. The remainder of the report's recommendations focuses on the areas where further testing is needed. A proposed work program for this testing will be developed and presented for future consideration.

The research potion of the concrete program achieved the following progress:

It confirmed that waste latex paint can be added as a replacement of the mix water in sidewalk and curb and gutter concrete mixes.

It identified that there are effects that need to be evaluated; hence further testing is needed before the concrete mix products can be defined and used for construction.

It identified that the characteristics of the collected waste latex paint need to be established and controlled.

Follow up research and Quality Assurance work is needed in each area.

The work and discussion on plant and equipment modification was based on the insights and experience of Mike Pratt of Blue Circle Materials with contributions from the other team members. As noted above, the consistency of the collected waste paint is important in developing proper batch proportions, and in day-to-day consistency of the concrete produced. Thus combining as much waste latex paint as possible into one container is an important advantage, as the proportions in larger combinations will tend toward the typical average content for each parameter. Keeping the waste paint well mixed is also important for the same reason. Mike Pratt advised that it is common in the ready mix industry to use plastic storage tanks with recirculating pumps to keep admixtures well mixed and ready for use. Thus a similar arrangement should likely be appropriate for the waste latex paint.

Taking this concept further, Mike Pratt suggested that the City might best store their collected paint in 1000 or 2000 litre totes, that could be transported to a ready mix plant for a given pour day and used to batch the sidewalk or curb and gutter work. (One 2000 litre tote would batch four 8 m^3 trucks at about a ~40% replacement rate. These four trucks would deliver enough concrete for a 170 metre length of sidewalk, or 470 metres of curb and gutter, or a 120 metre length of sidewalk plus curb and gutter.) (At a lower 10% replacement rate, which might be the best way to address the ready mix industry's handling concerns, the concrete quantities produced would increase to 4 times these values, and hence spread over much more construction work.) This tote would represent about an average month's collection.

The tote would be skid or trailer mounted and would have pumps for recirculation, that could also be used for batching. There are several details to be developed to allow compatibility with various Ready Mix Plants, and to maintain Quality Assurance. This method of provision from the Municipality will provide a higher quality waste latex paint product that will help overcome the handling and variability problems associated with waste material re-use. It poses a greater level of effort and responsibility on the municipality. This raises a number of questions regarding roles and responsibilities, that need to be addressed in a future phase of this study.

Forces are converging to focus the concrete program toward lower percentages of paint inclusion than previously hoped for, planned, and tested. These forces are:

- The Ready Mix Industry is suggesting that a 10% inclusion rate should eliminate their concerns regarding handling and damage to their transit mixers;
- The UWO testing shows that the effects of the waste paint on mix performance increase at increasing percentages of inclusion;
- The CPCA is advising that identifying and testing for surfactants in the collected waste paint would be expensive and ineffective;

Thus further development should be focused at lower percentages to avoid needing detailed data on waste paint, to avoid some degree of the effects on the concrete and to avoid detrimental effects on the transit mixers.

As a further note, based on the successes shown in this research, the Ready Mix Industry is also indicating that they would be interested in including waste latex paint in further products. Following the successful completion of the next stage of product development and verification for municipal concrete, there may well be additional product markets that could also see benefits from waste latex paint additions. Thus the concrete industry may be able to provide additional markets to receive waste latex paint. Research into further products should follow the confirmation in municipal concrete, as the municipal concrete mixes appear to have the most suitable mix bases and performance characteristics for the waste latex paint additions.

9. COMMUNICATIONS

This research has been shared with the participants and their organizations.

The Association of Municipal Recycling Coordinators of Ontario have provided feed back through the City, that raised concerns regarding the issue of permission to re-use products which might otherwise be interpreted as falling within designated waste classifications. The concern is with the fact that the "derived from rule" in the new Waste Management Regulations might classify the latex paint bearing concrete as being a waste and thereby impose inordinate and inappropriate controls on use of the material. This issue needs to be investigated and Ministry of the Environment acceptance established for the beneficial re-use of the waste latex paint in concrete products.

Feedback has also been given regarding the increased responsibility of Municipalities for the waste latex paint product they will provide (or sell) to the Concrete Producers. This issue needs to be discussed in the development of Standard Protocols for the supply of waste latex paint in the next phase.

Formal presentations of this data have not been made to the Ready Mix Concrete Association, as the data is not yet sufficiently developed to identify a set of concrete products with known characteristics. Similarly, no approach has been made to MTO. When the mixes are better defined, the field trial complete, and the benefits demonstrated, the MTO will be approached for consideration of OPSS Standardization of the mixes. This is known to be a 10 year process, as tests are conducted for that period to demonstrate long term acceptability. In the mean time, work will be conducted under the CSA A23 Standard.

10. CONCLUSIONS

1. There is a significant amount of collected waste latex paint that could be beneficially used in municipal construction products.

2. The waste latex paint cannot be used in hot mix asphalt products due to the effects of the high temperatures on the paint.

3. The asphalt industry has no interest in modifying cold mix asphalt emulsion products with latex paint, as the chemistry of the emulsions is already complex, and the waste paint would further complicate the chemical development process.

4. The waste latex paint can likely be used in municipal concrete for sidewalks or curb and gutter work.

5. Further testing is needed to confirm this and to refine the proportioning.

6. Further research will involve concrete laboratory testing, paint testing, field trials, and development of a recommended practice for including waste latex paint in municipal concrete.

7. Discussions with the Ministry of the Environment should take place and result in a constructive policy interpretation on the matter of classification of latex paint bearing concrete products.

11. RECOMMENDED FURTHER DEVELOPMENT

The results of this program are positive for the inclusion of waste latex paint in municipal concrete products. The program suggested below will advance the development of useable products and a source of waste latex paint. The program will include two components:

1. Develop two final recommended products, one for concrete sidewalk, and the second for concrete curb and gutter, each of which include waste latex paint. Provide documented laboratory testing to refine the allowable ranges of waste latex paint inclusion, and to demonstrate the concrete characteristics for these products. Provide field tests documenting their successful use and performance.

2. Develop a standardized procedure for the supply of waste latex paint from Municipalities to Ready Mix Concrete Producers. Include protocols for receiving, sorting, and transferring paint into totes. Include protocols for the totes and mixing systems. Include protocols for Quality Assurance testing of the stored paint.

1. Product development

Research is recommended firstly to refine the final recommended mixes and practices and secondly to provide documented assurance of the effects of the inclusion of waste latex paint in municipal concrete.

The two key goals will be establishing the most practical, optimized final products, especially with respect to the target percentage waste latex paint inclusion, and detailed confirmation of the performance and benefits of the optimized mixes.

Testing will be conducted in the laboratory, and in field trials.

Laboratory testing will confirm the characteristics of concrete mixes with a range of paint inclusions, from which Concrete Ready Mix Producers will be able to select optimum mixes for their applications.

Field trials will demonstrate the handling, finishing, and curing characteristics of mixes selected from those ranges.

Laboratory testing will be conducted in stages:

1. Stage 1. Optimizing the waste paint inclusion rate.

   Stage 1 will examine mixes with inclusion rates from 0 to 30%.

   Admixture dosages will be adjusted to suit the impacts of the waste paint additions.

   Tests will include setting time, 1, 3, 7 and 28 day strengths, air entrainment, slump, and general handling characteristics.

   From these results, the range of optimum inclusion rates will be selected by joint consensus of researchers and concrete producers.

2. Stage 2. Confirmation of the characteristics of the optimized mixes.

   Stage 2, will document the performance of the mixes for:

   i. Setting time, and early age properties

ii. Strength gain
iii. Beneficial post-curing gains due to added latex polymers
iv. Shrinkage effects
v. Surface scaling performance
vi. Alkali-silica reactivity effects
vii. Chloride permeability benefits
viii. Confirmation of containment of paint-added substances in the concrete

Field Trials will include casting lengths of sidewalk and curb and gutter with mixes which include normal mixes and a range of waste latex paint modified mixes. Results will be documented to confirm

i. Delivered concrete product characteristics: slump, and air entrainment.

ii. Effect on batching

iii. Truck handling and clean up

iv. Placing and finishing characteristics, and effect on contractor's operations

v. Setting, curing, and protection characteristics

vi. Laboratory tests on cores for strength, air void spacing factor and surface scaling

2. Paint Supply Protocols

The paint testing program will be continued to demonstrate the testing procedures and document the uniformity to be expected.

Meetings will be conducted with the staff of the Environment Assessments and Approvals Branch of the Ministry of the Environment to establish a constructive policy interpretation of t6he regulations applyng to the Management of waste latex paint in re-used applications.

Two aspects of paint supply need to be developed as standardized procedures or protocols:

Equipment to store and supply waste latex paint to Ready Mix Producers, and

Procedures to be followed to collect, separate, and store the waste latex paint.

The Ready Mix producers have recommended that the paint be stored in 2000 litre totes that can be transported to a Ready Mix Producer's batch plant for use on a particular project. In this project, a test tote system needs to be assembled and utilized to confirm the handling aspects for the Municipality and for the Ready Mix Producer. The tote would be assembled by the Ready Mix Producer, filled by the City, and transported and used by the Ready Mix Producer for the concrete mix field trials noted above. The tote would be modified if necessary to incorporate the lessons learned during these tests, and returned to the City for further storage, ready for future use. This tested and updated tote would be the prototype for the Standard and for future totes.

Currently, most municipalities do not bulk their waste latex paint for disposal. Currently, few attempt to find re-use opportunities. These municipalities' current practices will need to change as re-use becomes the norm. There will need to be discussion, development and acceptance by the municipalities of their roles and responsibilities for the re-use supply function. Similarly, private sector HSW providers will need to be included in these discussions.

Standard procedures, to be followed by the Municipality to establish a re-useable product, will be developed. The City of London already has collection, sorting, and storage procedures which can be the base for development. These need to be updated to include the use and management of the new tote storage system. Until now, these procedures were used for paint that was going to disposal. With the intent of re-use, comes a need for Quality Assurance procedures.

A group, which will need representation from Municipalities, private sector HSW providers, and the Ready Mix Producers, will work to develop these. These procedures will be documented in a Standard to be vetted by a committee of Municipal Recycling Coordinators, and Ready Mix Concrete Producers.

The Standard will be made available to Suppliers and Ready Mix Producers wishing to enter into re-use programs.

All of which is respectfully submitted by the Research Team

Earth Tech Canada Inc.
(On behalf of the Team)

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APPENDICES

Appendix 1 Test Results of London's Sampled Waste Latex Paint

Appendix 2 Feasibility Report – Concrete Mixes

Appendix 3 Asphalt Emission Test Report

APPENDIX 1 TEST RESULTS OF LONDON'S SAMPLED WASTE LATEX PAINT

APPENDIX 2 FEASIBILITY REPORT – CONCRETE MIXES

APPENDIX 3 ASPHALT EMISSION TEST REPORT