

I. Construction Innovation Forum • NOVA Award Nomination

Instructions

9404

Step 1 Enter a Descriptive Name for the Process/Method/Technique you are nominating on line A of this page.

Step 2 Complete this page.

"I. Construction Innovation Forum • NOVA Award Nomination"

- Be sure to provide original signatures in Section B and E on this page. Your nomination cannot be reviewed without them.
- If you need additional space for names and addresses you may attach additional pages for names and address information. You may attach extra pages only for sheet I.

Step 3 "II - Innovation Description" — attach one (one only) 8-1/2" X 11" page that gives a succinct written description of the innovation. Put the name of the innovation at top of page. Tell us what you think is innovative about this. You should include:

- What the innovation is
- Why it is innovative
- What it changed or replaced
- Where and when it originated, has been used, and is expected to be used in the future
- If the nomination is for an innovative project, specifically identify its innovations.

Please type, with 1" margins, 10 characters per inch, 6 lines per inch.

Step 4 "III - Innovation Illustration" — attach one (one only) 8 1/2" X 11" page that contains one or more photographs, drawings, tables, graphs, clauses, etc., that visually describe the innovation. Do not submit more than one page of visuals. The jurors will see only one sheet for review. Put the name of the innovation at top of page.

Other You must submit 12 (twelve) sets of sheets I, II and III (a total of 36 pages)

Nominations are due September 15 mailed or delivered to:
The Construction Innovation Forum, 1000 Campus Drive, Suite 100, Ann Arbor, MI, USA 48104-6792. Phone: 313-995-1855. Fax: 313-995-5002

A. Name of Innovation: RECYCLING RECLAIMED ASPHALT PAVEMENT

B. Person(s) and/or Organization(s) Primarily Responsible for the Innovation (Those to whom NOVA Award should be presented.)

Name: Robert Nath

Title: Chairman of the Board & Founder

Affiliation: CYCLEAN, INC.

Address: 6100 Jefferson St., NE

Albuquerque, NM 87122

Phone: (505) 344-0320

Signature: Robert Nath

(Signature(s) indicate acceptance of the nomination and consent to have CIF research and make presentations on the innovation for the purpose of jurying and publicizing awards.)

C. Other Primary Sources of Information on the Innovation: (In addition to the persons nominated above.)

Name: Robert Erickson

Title: Engineering Manager

Affiliation: CYCLEAN, INC.

Address: 1000 South IH-35

Round Rock, Tx 78681

Phone: (512) 244-2200

D. Independent Reference(s) familiar with the use of the Innovation

Name: Doug Coleman, P.E.

Title: Supervisor Bituminous
Technical Service Unit

Affiliation: Michigan Dept. of Transportation

Address: P.O. Box 30049

Lansing, MI 48909

Phone: (517) 322-1087

E. Person(s) making nomination:

Name: Richard Ford

Title: Executive Vice President

Affiliation: CYCLEAN, INC.

Address: 1000 S. IH-35

Round Rock, TX 78681

Phone: (512) 244-2200

Signature: Richard Ford by XHP

(Signature(s) indicate familiarity with the innovation and signify that information contained in the nomination is correct to the best of one's knowledge.)

CYCLEAN®

WHAT RECYCLING WAS MEANT TO BE

NAME OF INNOVATION: RECYCLING HIGH-PERCENTAGE RECLAIMED ASPHALT PAVEMENT

II - INNOVATION DESCRIPTION

What the innovation is: a proprietary microwave and cool-flow process to recycle high-percentage reclaimed asphalt pavement into hot-mix asphalt.

Why it is innovative: CYCLEAN®'s process uses microwave and a cool-flow air stream to gently heat the reclaimed asphalt pavement (RAP). Gentle heating prevents damage or "coking" of the RAP. The RAP is first gently heated to remove any excess moisture. Then a small amount of rejuvenating agent is added to replace the light-end oils that evaporate during the normal aging process of asphalt pavement. The final mixture is brought to the desired paving temperature of 300°F by the application of microwave energy. As the microwaves vibrate the aggregate polar molecules, the rock gently heats and diffuses warmth into the surrounding asphalt cement. The microwave also enhances the binding characteristics of the polar molecules. Testing of the aging characteristics of five-year old recycled asphalt pavement indicates that recycled asphalt ages less than comparable virgin asphalt.

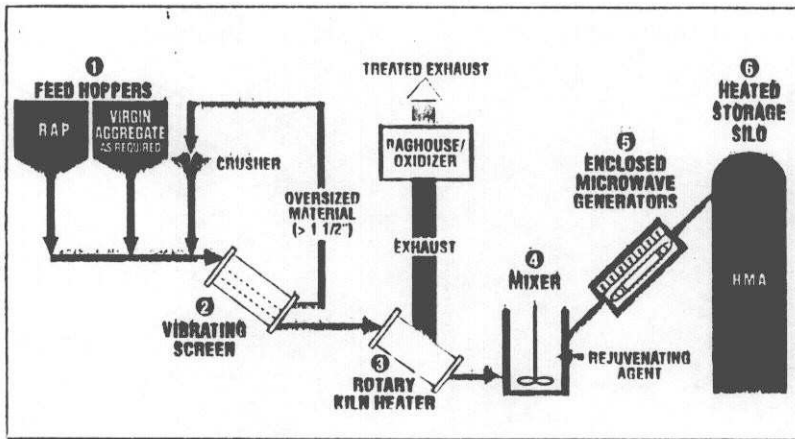
The direct environmental aspects of the innovation include:

1) less air pollution than a comparable virgin plant and 2) the need for raw material is reduced as the reclaimed asphalt already contains aggregate and asphalt cement, the ingredients of asphalt hot-mix. Indirect benefits include: 1) reduced landfill waste 2) less air pollution due to trucking and 3) reduced need for petroleum based products like gasoline and binder material.

What it changed or replaced: Competitive processes are limited in the percentage of reclaimed material they can use without damage to the material properties of the RAP or to the air quality. The CYCLEAN® process can recycle up to 100% RAP into a virgin quality hot-mix without any of the "side-effects" of excessive smoke or coking. The maximum RAP that a competitor can recycle is about 50%. Most competitors recycle only 25-35% RAP.

Where and when it originated, has been used and is expected to be used in the future: The CYCLEAN® process was invented by Robert Nath. The company was formed in 1983 and has processed about one-million tons of hot-mix in the U.S. The company also has a successful licensee in the Netherlands. CYCLEAN® is currently recycling asphalt for the Pennsylvania Turnpike Commission, and for the City of Los Angeles, Bureau of Street Maintenance. We have also recycled asphalt in Michigan, Georgia and Texas. A Dutch consortium purchased a recycling facility from CYCLEAN® to recycle RAP for the Government of Netherlands in 1992. We are currently working to develop projects in Indiana, Florida and a second facility in California.

RECYCLING RECLAIMED ASPHALT PAVEMENT



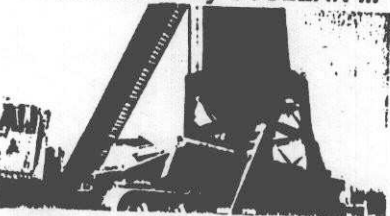
The CYCLEAN process produces hot mixed asphalt (HMA) from reclaimed asphalt pavement (RAP). Major system components include (1) feed hoppers supplying RAP and virgin aggregate to the process, (2) a vibrating screen to size feed material, (3) a rotary kiln heater that preheats feed materials, (4) a mixer in which a proprietary rejuvenating agent is added, (5) enclosed microwave generators that heat the mixture, and (6) a heated product storage silo.



Milled from existing pavement



... processed by CYCLEAN ...



... and returned to its best use



CYCLEAN

AWARD MANAGER'S SUMMARY

AWARD MANAGER'S SUMMARY
Nomination 9404

RECYCLING HIGH-PERCENTAGE RECLAIMED ASPHALT PAVEMENT

The Innovation

This nomination is for a process to recycle asphalt pavement while maintaining a high percentage of reclaimed asphalt in the final hot-mix. It is a proprietary process of CYCLEAN, Inc. The process uses a cooler than normal air stream and microwave energy to gently heat the reclaimed asphalt pavement. This gentle heating prevents burning damage or "coking" of the asphalt contained in the old pavement mix.

The reclaimed asphalt pavement (RAP) is first crushed and screened to obtain the desired mix of aggregate sizes. To remove excess moisture, the RAP passes through a rotating drum and humidity controlled warm air preheats the material to about 220°F. The heating flame does not touch the mix, since the heating drum has a double wall that protects the asphalt in the mix from being overheated or burned.

Exhaust air from the dryer drum passes through a cloth-filter baghouse that removes particulate matter, and then passes through an afterburner, or oxidizer, that removes any hydrocarbons before the air is discharged to the atmosphere.

The preheated paving material moves to a pugmill mixer where spray applicators add controlled amounts of asphalt rejuvenator. Only a small amount of rejuvenating agent is added to replace the light-end oils that have evaporated during the normal aging process of the old asphalt pavement.

The mix then goes on a conveyor to the microwave area where the final mixture is brought to the desired paving temperature of 300°F to 350°F by the application of electromagnetic energy.

The aggregate molecules in the RAP can be said to be polar in nature while the asphalt molecules are not. Polar molecules subjected to electromagnetic energy vibrate and become hot. Hence, when the microwaves excite the aggregate's polar molecules, the rock gently heats and diffuses warmth into the surrounding asphalt cement. However, in some instances, the heating of the aggregate to its final temperature can be accomplished without the use of the microwave.

While the microwave's primary use is to increase the final temperature of the mix, it is also believed that it contributes to the alignment of the polar molecules in the mix which increases the adhesion between the aggregate and the asphalt. This concept apparently comes from research done under the Strategic Highway Research Program (SHRP).

There seem to be a number of advantages gained by the use of the CYCLEAN system:

- (a) Since the material can be heated without burning the asphalt, high percentages of recycled asphalt can be included in the final mix. It has been postulated that 100% recycled asphalt can be achieved, however somewhat lesser amounts are being used because of specific project factors.
- (b) The handling of the exhaust air from the drying drum through the oxidizer produces almost no air pollution.
- (c) The need for raw material is reduced as the reclaimed asphalt already contains asphalt cement and aggregate, the ingredients of conventional asphalt hot-mix.
- (d) The greater use of recycled pavement reduces the amount of landfill waste.
- (f) The lesser use of trucking to dispose of unrecycled pavement reduces air pollution.
- (g) The process reduces the need for petroleum based products like, rejuvenating agent, gasoline, and binder material.

Background of Innovation

The original idea for the CYCLEAN process came from Robert Nath and he worked with employees of CYCLEAN to develop the system. Mr. Robert Erickson was instrumental in designing the "cool flow" aspect of the process which keeps the mixing temperatures low.

The CYCLEAN company was formed in 1983 and significant funding from venture capitalists was obtained in 1985. The first trial of the system was made in Austin Texas, and a number of small jobs were installed. The "real opener" was in 1987 in Los Angeles where they have recycled about one million tons of asphalt paving since that time. The choice by Los Angeles appeared to have been made because of the system's low air pollution.

Some problems with burning of the asphalt, smoke from the stack, and high pollution were experienced during the development of the process. These have been corrected by the redesign of the old drying-heating system, the use of a specialized burner, and other improvements.

About five different patents have been issued and several are being applied for. Mr. John Wiley, Electrical Systems Engineer, and Mr. Robert Erickson, Mechanical Engineer, are two people presently in the company who are participating in patent applications.

Application

The CYCLEAN company has grown steadily since its founding in 1983 and is currently recycling asphalt for the Pennsylvania

Turnpike Commission, and for the City of Los Angeles, Bureau of Street Maintenance. They have also recycled asphalt in Michigan, Georgia and Texas. The company is currently working to develop projects in Indiana, in Florida, and in California.

The company is expanding abroad as well as in the United States. It has a successful licensee in the Netherlands and, in 1992, a Dutch consortium purchased a recycling facility from CYCLEAN to recycle RAP for the Government of Netherlands. The process is spreading to other European Countries and to Japan.

Notes on Nominated Persons

Mr. Robert Nath is Chairman of the Board and Founder of CYCLEAN Inc.

Mr. Nath says that the FHWA is watching the developments of CYCLEAN with interest, but has not given any official endorsement. The reason might be that many of the old recycling plants could be put out of business, yet they are still needed to meet paving demands. Also the Asphalt Institute is not openly happy with the CYCLEAN system.

Mr. Nath also says that the temperature in the kiln and the mix is well controlled and creates a "cool flow" environment for the mix. There is no local burning or hot spots. The stack emissions have been measured extensively and the pollution level is very low. The CYCLEAN rejuvenator is not exclusive and other rejuvenators can be used.

Opinions of Outside Persons

Mr. Douglas Coleman, P.E.

Mr. Douglas Coleman is Supervisor, Bituminous Technical Service Unit of the Michigan Department of Transportation. In the summer of 1993 he was attached to a paving project on Gratiot Avenue in the City of Detroit where 30,000 tons of recycled asphalt was placed using the CYCLEAN process.

Mr. Coleman thinks that the process is innovative, but that the microwave is not too vital. However, the whole heating-mixing process allows for a use of a high percentage of old asphalt in the mix. On this project they used 80%.

If the microwave is removed, the equipment does not look much different from a regular recycling plant. However, Mr. Coleman thinks that there are innovations in the rotary kiln heater because the smokestack exhaust looks very clean. In regular recycling one can see blue smoke coming from the stack.

Mr. Coleman believes that Michigan DOT may use the process in the future. Presently, a maximum of 50% of the old asphalt is recycled in Michigan. The stock piles of old material are growing and MDOT will be forced to use more old material. He predicts that in about five years MDOT will use CYCLEAN, or similar methods, to raise the use of the old material to 80% or more. There are some problems with going to 100% recycled material. The old mix already contains enough asphalt cement and if a rejuvenator is added, there may be too much asphalt cement in the mix.

Mr. Coleman does not think highly of the claim that the microwave oven enhances adhesion (the polar molecule theory) and therefore believes that mixes can be made without the microwave.

Mr. Robert Erickson

Mr. Robert Erickson is Engineering Manager for CYCLEAN, Inc. He played a major role in the development of the CYCLEAN process.

Mr. Erickson says that the CYCLEAN setup may look similar to some regular asphalt plants but the process and inside parts are different. The emphasis is on "cool flow," well controlled temperature, so that the mix never has a chance to burn or smoke.

Mr. Erickson believes that the future for CYCLEAN is expanding. He thinks that as the old pavement material piles grow, there will be more use for the method. The Asphalt Institute is not very happy because lesser amounts of virgin asphalt will be sold.

Mr. Richard Ford

Mr. Richard Ford is Executive Vice President of CYCLEAN, Inc. He is a graduate Mechanical Engineer from the University of Michigan, but now is in the finance and marketing area of the company. His main role is promoting the CYCLEAN process.

Mr. Ford travels much of the time and has heard of a setup being used in the New York/New Jersey area that also claims to be able to utilize up to 100% RAP. He believes that it is not used much and is not well known. He does not know the name or address.

Mr. Ford says that the future of the company looks good. They are expanding and plan to set up a plant in Detroit.

Mr. Charles H. Van Deusen

Mr. Charles H. Van Deusen is a consulting engineer to the asphalt industry. He has extensive experience in the asphalt paving business. He is very well known throughout the asphalt industry.

Mr. Van Deusen says that you cannot always recycle 100% of the old material. On The Gratiot Avenue project in Detroit the basic aggregate was slag, so a high percentage could be recycled. Afterwards, the equipment was moved to Indianapolis, IN, and lower recycling values had to be used because of the gravel aggregates.

Mr. Van Deusen also said that there is a question about the hardness (or viscosity) of the asphalt in the new mix if 100% recycling is employed. If the asphalt in the old pavement is hard from aging, a considerable amount of rejuvenating agent is needed to soften the asphalt. If the old mix already has enough asphalt, not much rejuvenating agent can be added if recycling level is to be 100%. Thus, the asphalt may stay hard in the new mix and the pavement may crack, especially at cold service temperatures.

It is possible to heat the mix in the kiln to the needed temperature, say 300°F, and not use the microwave at all, or use it only to activate the polar molecules and improve adhesion.

Mr. Van Deusen thinks that there will never be a surplus of old asphalt pavement material, because it is used as an additive to new, fresh mixes. Further, one should think not only about public highways, but also about large quantities used in private work.

Award Managers' Comments

The CYCLEAN process appears to be an advance in recycling asphalt pavement. Conventional processes are limited in the percentage of reclaimed material that can use without damage to the material properties of the RAP or to the air quality. Conventional recycling plants can recycle only about 25% to 35% of the old pavement. The CYCLEAN process may, under ideal conditions, recycle up to 100% RAP depending upon the properties of the old material. The process can produce virgin quality hot-mix without the side-effects of excessive smoke or coking. The process appears to minimize environmental pollution.

SELECTED INTERVIEW SUMMARIES

Phone Interviewer: Tons
Date: 11/18/93

#9404
No. 1

Name: Mr. Richard Ford
Title: Executive Vice President
Affiliation: CYCLEAN, Inc.
1000 South IH-35
Round Rock, TX 78681

1. Mr. Ford says that the most innovative aspect of the process is the ability to recycle up to 100% Reclaimed Asphalt Pavement (RAP) without burning it and polluting the air.
2. Ford is traveling all the time and he has heard of a setup being used in the New York/New Jersey area that also claims to be able to utilize up to 100% RAP. It is not used much and not well known. He does not know the address.
3. The original idea for the innovation came from Robert Nath. At the time when the idea started, there were two other partners. They left the company before the system was developed. Presently there are two people in the company who are participating in patent applications. They are: John Wiley, Electrical Systems Engineer and Robert Erickson, Mechanical Engineer.
4. Ford graduated from the University of Michigan in Mechanical Engineering and now is in finance and marketing for the company. His role was to promote the idea. Today, Ford is in Detroit trying to sell one of these recycling plants to the City of Detroit. (He is confident that he will sell it.)
5. The first trial of the system was done in Austin Texas. But the real opener was Los Angeles where they have recycled about one million tons of asphalt since 1987. They had some problems with burning of the asphalt, smoke from the stack, and high pollution, so they redesigned the old drying-heating system using a specialized burner and other improvements.
6. The future looks good. They are expanding and plan to set up a plant in Detroit.
7. He will send some literature which he thinks is important.

Phone Interviewer: Tons
Date: 11/22/93

#9404
No. 2

Name: Mr. Charles H. Van Deusen
Title: Consultant
Affiliation: 21160 East Farm Lane
Northville, MI 48167

1. Mr. Van Deusen says that the most innovative aspect is that you can recycle a high percentage of the old asphalt paving material. The equipment works well and the production is good.
2. You cannot always recycle 100%. On Gratiot Avenue, the basic aggregate was slag, so a high percentage could be recycled. Afterwards, the equipment was moved to Indianapolis, IN, and they had to work with lower recycling values using gravel aggregates.
3. They have built a sophisticated kiln-exhaust-baghouse combination. The heating flame does not touch the mix. It has a double wall heater which protects the asphalt in the mix from being overheated or burned. The exhaust passes through a baghouse/oxidizer at 1400°F. The treated exhaust is "clean."
4. The material from the kiln goes to the mixer (at about 250°F) and a "rejuvenator" is added. After that the mix goes on a conveyor to the microwave where the temperature is raised to about 300°F. It is also theorized that the microwaves enhance the adhesion between the rock and the asphalt.
5. It is possible to heat the mix in the kiln to the needed temperature, say 300°F, and not use the microwave at all, or use it only to activate the polar molecules and improve adhesion.
6. There is a question about the hardness (or viscosity) of the asphalt in the new mix if 100% recycling is employed. If the asphalt in the old pavement is hard from aging, a considerable amount of rejuvenating agent is needed to soften the asphalt. If the old mix already has enough asphalt, not much rejuvenating agent can be added if recycling level is 100%. Thus, the asphalt may stay hard in the new mix and the pavement may crack, especially at cold service temperatures.
7. Van Deusen thinks that there will never be a surplus of old asphalt pavement material, because it is used as an additive to new, fresh mixes. Further, one should think not only about public highways, but also about large quantities used in private work.

Phone Interviewer: Tons
Date: 11/22/93

#9404
No. 3

Name: Mr. Robert Erickson
Title: Engineering Manager
Affiliation: CYCLEAN, Inc.
1000 South IH-35
Round Rock, TX 78681

1. Mr. Erickson says that the process is innovative. Large percentages of old asphalt can be mixed and placed without much pollution.
2. The setup may look similar to some regular plants but the inside parts and process is different. The emphasis is on "cool flow" (well controlled temperature) so that the mix never has a chance to burn or smoke.
3. Robert Nath was the originator of the process. There were 3 or 4 other people involved, but they are not active. This should be checked with Robert Nath.
4. Mr. Erickson was instrumental in designing the "cool flow" aspect in the process. (to keep the temperatures low.) He says that the mixing plant can sometimes be run without the microwave. He did not want to divulge all details of the plant setup because some parts of the process have patents and others are secret. Apparently the mix is heated to about 250°F at the rotary kiln heater and the microwave oven jacks it up to about 300°F.
5. The company started with small jobs in 1985. Erickson will send us some literature and a VCR film. They have put mixes out on the road on the Pennsylvania Turnpike, in Harrisburg, Pittsburgh and various other places in the east, and a large quantity in Los Angeles. (1,000,000 tons.)
6. The future is expanding. He thinks that as the old pavement material piles grow, there will be more use for their method. The Asphalt Institute is not very happy because less virgin asphalt will be sold.
7. Mr. Erickson says that there are patents. We should talk to Nath.
8. Mr. Erickson will send some literature.

NOTE: Erickson admits that the microwave may be most useful for activating polar molecules for better adhesion in the mix.

Phone Interviewer: Tons
Date: 11/22/93

#9404
No. 4

Name: Mr. Robert Nath
Title: Chairman of the Board and Founder
Affiliation: CYCLEAN, Inc.
6100 Jefferson St., NE
Albuquerque, NM 87122

1. The most innovative aspect of the nomination is to heat and mix 100% recycled asphalt mix to 300^o-350^oF without pollution (almost no pollution). This is done by the system, especially the new-design rotary kiln heater. The microwave can be used for jacking up the final temperature, but sometimes it is not used for this purpose. The microwave is thought to contribute to lining up polar molecules in the mix for better adhesion. This idea apparently comes from some research done by SHRP.
2. The temperature in the kiln and the mix is well controlled, creating a "cool flow" environment for the mix without local burning and hot spots. The stack emissions have been measured extensively and the pollution level is very low. The rejuvenator is not exclusive and other rejuvenators can be used.
3. Mr. Nath says that there is nothing similar to this. The FHWA is watching the developments with interest, but has not given any official endorsement because this may put out of business many of the old recycling plants and they are still needed. Also the Asphalt Institute is not openly happy.
4. The activity started around 1987 in Los Angeles. Lots of tons were placed there. Mr. Nath claims it was his idea.
5. Mr. Nath was the leader of the development working with employees of CYCLEAN.
6. They had heating and emissions control problems for some time in Los Angeles and other places. These were solved with time.
7. The future looks good. Los Angeles uses the process. It is used in Holland and is spreading to other European countries. Also Japan will use it soon.
8. There are about five different patents and several are in progress. Mr. Nath will send some of them to us.
8. Nath will send us some pertinent literature. Detailed explanations are not available but he is willing to answer some questions if needed.

Phone Interviewer: Tons
Date: 11/22/93

#9404
No. 5

Name: Mr. Doug Coleman
Title: Supervisor, Bituminous
Technical Service Unit
Affiliation: Michigan Department of Transportation
P.O. Box 30049
Lansing, MI 48909

1. Mr. Coleman works for Michigan DOT. Last summer he was attached to a paving project on Gratiot Avenue where they placed 30,000 tons of recycled asphalt. He thinks that the process is innovative, but the microwave is not so vital. However, the whole heating-mixing process allows high percentage of old asphalt in the mix (They used 80%) and the pollution emissions looked clean.
2. If the microwave is taken out, the equipment does not look much different from regular recycling. However, Mr. Coleman thinks that there are innovations in the rotary kiln heater operations because the smokestack exhaust looks very clean. In regular recycling one can see blue smoke coming from the stack. He almost suggested that the process may work without the microwave.
3. Mr. Coleman does not know much about the originator of the process. He met Richard Ford from CYCLEAN at a meeting and decided to try the method.
4. Mr. Coleman is a user and did not help to promote the method.
5. Mr. Coleman says that Michigan DOT may use the process in the future. Presently, a maximum of 50% of the old asphalt is recycled. The stock piles are growing and MDOT will be forced to use more of the old stuff. He predicts that in about five years MDOT will use CYCLEAN or other methods to jack up the use of the old material to 80% or more. There are some problems with going to 100% recycled material. The old mix already contains enough asphalt cement and if a rejuvenator is added, there may be too much asphalt cement in the mix.
6. Mr. Coleman says to call Chuck Van Deusen for additional information at 313-474-4417.
7. The penetration (hardness) value of the old Gratiot Avenue asphalt cement was 25. This is a value at which the asphalt is hard and tends to cause cracking in asphalt pavement. Coleman says that MDOT requires that a rejuvenated mix after heating, mixing, placing, and rolling should contain recovered asphalt with penetration 40-50 (in the lower peninsula) to resist low temperature cracking. The Gratiot job had the rejuvenated recovered asphalt penetration values of 35-38. This is below the 40 minimum value, and the recycled amount was not 100% but around

80%. If 100% would have been used, less rejuvenator would have been added to satisfy other mix properties and the rejuvenated, extracted penetration values would have been below the 35-38 values. In other words, if 100% recycled asphalt mix is used, it may not be possible to add any rejuvenator and the new recycled pavement may be susceptible to cracking, especially in cold climates.

8. Mr. Coleman says that the range of recovered asphalt penetration for old asphalt pavements is 20-30.

9. Mr. Coleman does not think highly of the claim that the microwave oven enhances adhesion (the polar molecule theory) and therefore mixes could be made without the microwave.

CONTACTS MADE

Contacts Made

Name: Mr. Doug Coleman
Title: Supervisor, Bituminous
Technical Service Unit
Affiliation: Michigan Department of Transportation
P.O. Box 30049
Lansing, MI 48909

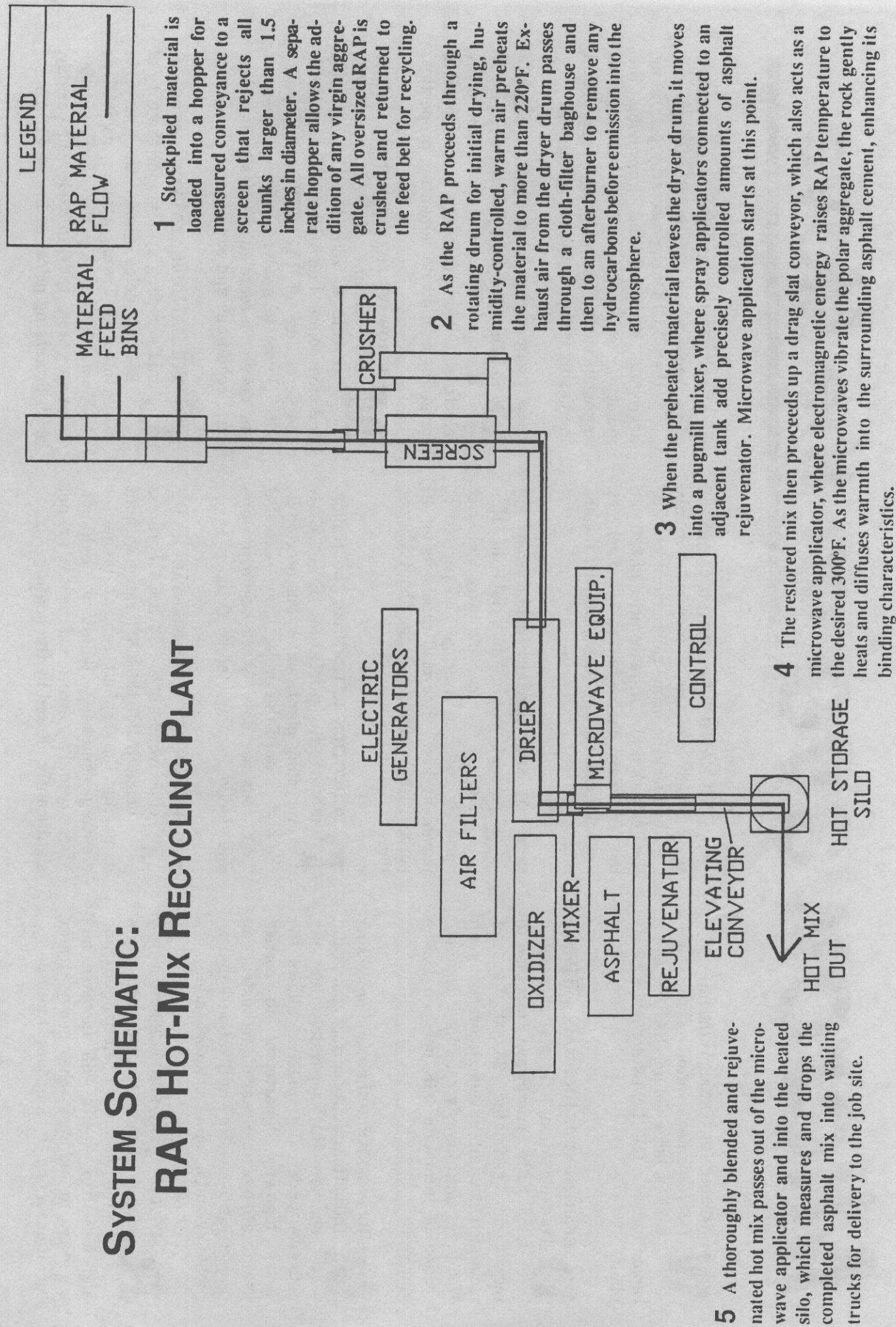
Name: Mr. Robert Erickson
Title: Engineering Manager
Affiliation: CYCLEAN, Inc.
1000 South IH-35
Round Rock, TX 78681

Name: Mr. Richard Ford
Title: Executive Vice President
Affiliation: CYCLEAN, Inc.
1000 South IH-35
Round Rock, TX 78681

Name: Mr. Robert Nath
Title: Chairman of the Board and Founder
Affiliation: CYCLEAN, Inc.
6100 Jefferson St., NE
Albuquerque, NM 87122

Name: Mr. Charles H. Van Deusen
Title: Consultant
Affiliation: 21160 East Farm Lane
Northville, MI 48167

SYSTEM SCHEMATIC: RAP HOT-MIX RECYCLING PLANT



Microwave on the Move

WAXAHACHIE, TEXAS, is the latest site for a demonstration of the high-caliber, large-volume RAP recycling capabilities of a CYCLEAN hot-mix asphalt plant.

DEPARTMENT OF HIGHWAYS and Public Transportation officials chose the CYCLEAN microwave process to recycle an estimated 93,000 tons of reclaimed asphalt pavement overlying an 18.5-mile, continuously reinforced concrete section of Interstate 35E between Dallas and Waco.

MILLING, STOCKPILING and processing the better quality surface course and shoulder RAP separately from any defective underlying material allows the Texas highway department to correct deterioration of an 8-year-old reconstruction project due to moisture infiltration, sub-base problems and bonding seal coat failure.

RECYCLING THE SURFACE material by adding about 10 percent virgin aggregate and 1 percent recycling and anti-strip agents will increase mix stability to address the heavy traffic conditions along the four-lane mainline.

CYCLEAN'S SUBCONTRACT BID of \$16.87 per ton of recycled hot mix helped the prime contractor to secure the job with a low, in-place price of \$23 per ton. Standard paving and rolling machines are being used to apply and compact the hot mix.

HOT MIX ASPHALT made from 100 percent virgin materials in this North Texas highway district normally costs an average \$36 per ton of pavement laid. Recycled mixes using 40 percent RAP usually average about \$29 per ton.

PRODUCTION RATES from the trailer-mounted, portable CYCLEAN recycling plant, which was erected at the mid-point of the project, have exceeded 2,000 tons per day. Work began in June and should be completed by October.

TECHNOLOGY FUNDAMENTAL to the effectiveness of the CYCLEAN process heats RAP to the 300°F range without damaging the asphalt cement binder or creating smokey, polluting exhaust. Viscosity and penetration of the RAP are not significantly altered by the heating.

ELECTROMAGNETIC, microwave energy benefits the hot mix resulting from the CYCLEAN process by polarizing the aggregate particles and improving the molecular orientation of asphalt film to aggregate surface, augmenting adhesion and increasing resistance to stripping.

BREAKTHROUGH FINDINGS recently announced by the Strategic Highway Research Program show that polar (electrostatic) forces actually are responsible for giving asphalt its cementing properties.

MICROWAVE MIX DESIGN can include any amount of RAP, from 100 percent to zero, but the economic and environmental advantages increase with the percentage of RAP. CYCLEAN works with clients to analyze existing pavement and develop a recycled mix design based on local conditions and experience.

CYCLEAN CURRENTLY OPERATES hot-mix recycling systems for the City of Los Angeles and the Georgia Department of Transportation, as well as the Texas highway department. Production rates vary from 1,000 to 3,000 tons per day, with processing prices as low as \$12.25.

CYCLEAN®
WHAT RECYCLING WAS MEANT TO BE

1000 South IH-35
Round Rock, TX 78181

P. O. Box 200816
Austin, TX 78720-0816

(512) 244-2200
FAX (512) 244-2622

AUG 21 1992

NEWS RELEASE

EMBARGOED
For Release June 24, 1992

Contact:
Katharine Phillips
(415) 399-1138

**LOS ANGELES PROGRAM TO RECYCLE PAVEMENT RECEIVES
NATIONAL ENVIRONMENTAL ACHIEVEMENT AWARD**

Los Angeles, CA, June 24 -- The City of Los Angeles Bureau of Street Maintenance has been selected to receive the Renew America Environmental Achievement Award for its Recycled Asphalt Pavement Program, it was announced today in Washington, D.C. The Renew America Environmental Achievement Award is the only national award bestowed by leaders of the environmental community. It is presented to environmental programs for their success in protecting the environment, inspiring others to take environmental action and reaching community goals.

In an effort to reduce paving costs, traffic congestion and air and ground pollution, Los Angeles salvages Reclaimed Asphalt Pavement (RAP) and processes it into new paving materials for use in the resurfacing of city streets. Before the Bureau of Street Maintenance began the program in 1987, used asphalt was disposed of primarily in landfills, and only virgin mix asphalt was used to maintain streets. The Bureau now converts this waste material into a quality recycled asphalt concrete product. The process has saved the city approximately \$8 million in material costs over the past five years. The Bureau spends \$41 million on street resurfacing and related street maintenance activities annually.

OVER

By recycling asphalt pavement, the Bureau has:

- Reduced the amount of RAP transported to landfills by over 800,000 tons since 1987, thus saving landfill space and disposal costs.
- Reduced the need for virgin materials by over 800,000 tons used to manufacture new asphalt.
- Reduced the amount of petroleum oil needed to produce asphalt cement binder used in manufacturing new asphalt by 7,938,000 gallons, or 189,000 barrels of crude oil.
- Reduced air pollution by decreasing transportation and traffic congestion to and from landfills.

"In treating used asphalt as a resource instead of valueless waste material, the City of Los Angeles' Bureau of Maintenance has presented an example of utility and resourcefulness that all U.S. cities would do well to follow," says Tina Hobson, executive director for Renew America.

A representative of The Recycled Asphalt Pavement Program will travel to Washington, D.C. to receive the award at the Third Annual Renew America Awards Ceremony in the Fall. William C. Reilly, administrator for the Environmental Protection Agency will be honorary chairman.

Based in Washington, D.C., Renew America is a nonprofit organization committed to restoring our nation's communities through environmental action. The Renew America Environmental Achievement Awards were established to recognize and promote successful projects around the country that will serve as environmental models.

Recycled asphalt binder can meet SHRP specs

Putting back aromatic rejuvenator oils produces a material quite similar to virgin asphalt, writer says; aromatics possess high penetrating character

by Gail M. DeLong

The intent of the proposed Strategic Highway Research Program (SHRP) asphalt binder specification is to specify all binder types (virgin, modified and recycled). SHRP has been, and still is, undergoing an extensive study of virgin and modified binders in developing these specifications, but recycled binders have been overlooked.

Realizing the importance of asphalt recycling in road reconstruction, Dr. David Anderson and Don Christensen (from Penn State University) and myself, with funding from Sun Co., undertook an investigation. Results were presented at the 4R Conference and Road Show in Cincinnati. Highlights of the presentation include not only the finding that recycled asphalt binder can meet the new SHRP specifications given the proper rejuvenating agent, but also the discovery of new insights into asphalt structure.

Binder technology

To understand what is happening when a pavement ages and what is needed to reverse or rejuvenate the aging process, one must understand the structure of asphalt. SHRP researchers have presented a theory in which asphalt is a network of amphoteric asphaltene-type molecules. An oil phase is contained within the network.

The most important asphalt chemical properties may be the molecular

Ms. DeLong is sales and technical representative, Renkert Oil Inc. Edited by Tom Kuennen from a presentation at the Fifth International 4R Conference & Road ShowSM, Cincinnati, December 1991.

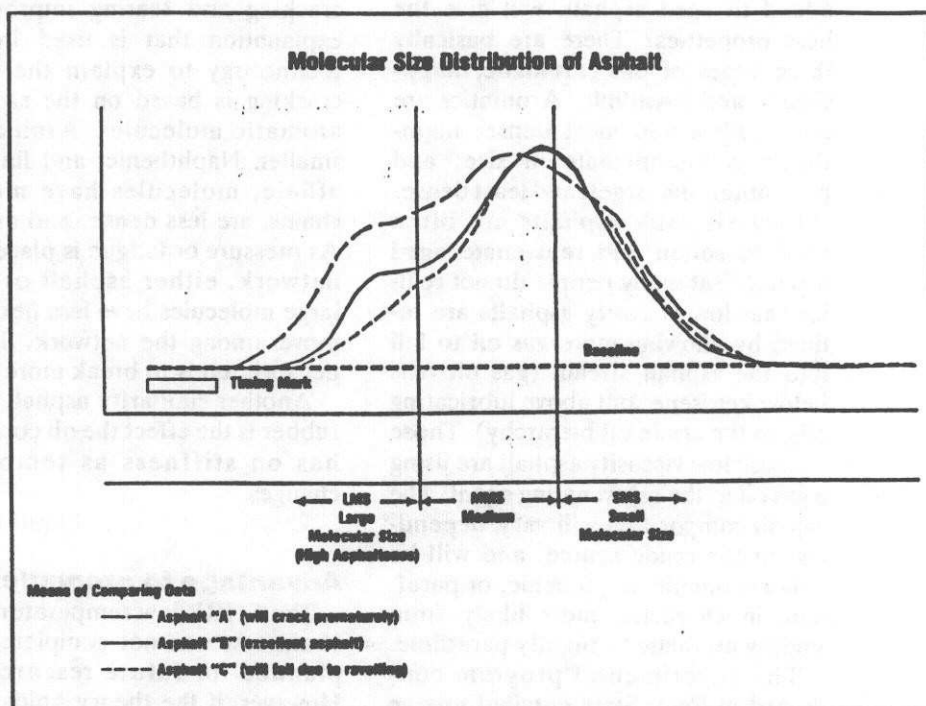


Fig. 1—Molecular size distribution of asphalt

size distribution (MS) of the network, the MSD of the oil phase, and the polar interactions which hold the network together.

Dr. Wynn Jennings of Montana State University found that the amount of large molecular size components in asphalt plays a role. Fig. 1 shows that asphalt B is an excellent asphalt and contains the right amount of large molecular size or "network" components. Asphalt A has too much network and not enough oil; it will crack. Asphalt C has too little network compared to the oil portion; it will ravel. Aging will move a B asphalt to an A asphalt as the oil phase (generally the aromatic portion) oxidizes to

asphaltenes.

Dr. Jennings' discovery is enlightening but not complete. It does not include information about the oil phase composition, nor the network structure and polar interactions. These chemical properties are difficult to measure and still not fully understood. Thus, rheology—a measure of viscoelastic properties—has developed into a convenient physical property measure that links chemical properties to asphalt performance. Rheology does pick up chemical property differences. The new SHRP specifications are rheology-based.

Similarities to rubber must be pointed out. Rubber is also a network

(a polymer network) with oil (called extender oil) contained within the network. In fact, a rubber tire contains 25% oil. The molecular size distribution of the polymer network and the oil—along with the network chemical bonds—are important in defining rubber quality. Rheology is an important measure of polymer molecular size and overall quality. Polymer added to asphalt (polymer modified asphalt) essentially adds network, different network bonds, and many times, a different oil phase (rubber extender oils generally are added).

Asphalt recycling

Dr. Jennings' work tells us that an aged asphalt is an asphaltene network lacking oil. But what type of oil, when added to aged asphalt, will give the best properties? There are basically three types of oils: aromatic, naphthenic, and paraffinic. Aromatics are the smallest and most dense; naphthenic is intermediate in size; and paraffinic is the largest and least dense.

Low viscosity asphalts are often used to soften and rejuvenate aged asphalt. But many people do not realize that low viscosity asphalts are refined by allowing more gas oil to fall into the asphalt stream (gas oil falls below kerosene, but above lubricating oils, in the crude oil hierarchy). Those who use low viscosity asphalt are using a gas oil as the rejuvenating agent. The gas oil composition will vary, depending on the crude source, and will be either aromatic, naphthenic, or paraffinic in character, most likely from slightly aromatic to slightly paraffinic.

The experimental program conducted at Penn State entailed mixing binder extracted from aged asphalt with aromatic, naphthenic, gas oil (representing a slightly paraffinic oil), and two very different AC-5 asphalts. The new SHRP rheology specification tests were run on all unaged mixtures.

Please realize that the amount of AC-5 needed to soften the aged asphalt is much greater than that of an oil. Thus the AC-5 mixtures take on some of the AC-5 network character, which tends to blur the results of these two mixtures.

The aromatic oils and one of the AC-5 asphalts produced very acceptable paving grade asphalts. The naphthenic, gas oil, and other AC-5 did not meet the fatigue cracking specifications. As total aromatics (aromatics plus polars) of the oil phase increase, the temperature where fatigue damage occurs decreases.

New emulsion brochures from AEMA

The Asphalt Emulsion Manufacturers Association (AEMA) has introduced two new brochures: *Asphalt Emulsion Aggregate Mix Descriptions*, and *Pavement Recycling with Asphalt Emulsions*. Designed to complement the popular *Surface Treatments* brochure, a set of these pamphlets makes an informational

tool which anyone with road responsibilities will find useful.

Single copies are available for \$1.00 each—a set of all three for \$3.00—and may be ordered postpaid from AEMA, No. 3 Church Circle, Suite 250, Annapolis, Md., 21401, (401)267-0023. □

Parallels to rubber

What's interesting is how these results parallel rubber technology. As the aromaticity of the rubber extender oil increases, rubber's resistance to cracking and tearing improves. The explanation that is used in rubber technology to explain the reduced cracking is based on the size of the aromatic molecules. Aromatics are smaller. Naphthenic, and finally paraffinic, molecules have more side chains, are less dense, and are larger. As pressure or fatigue is placed on the network, either asphalt or rubber, large molecules have less flexibility to move among the network. Thus, the network tends to break more readily.

Another similarity asphalt has with rubber is the effect the oil composition has on stiffness as temperature changes.

Advantage to aromatics?

The SHRP low temperature tensile strain test was not completed and is planned for future research work. However, if the theory holds that the asphalt is similar to rubber in structure and behavior, aromatics may hold an advantage here. Aromatics improve tensile strength in rubber at room temperature. As temperature decreases, this advantage will gradually diminish until the brittle point is reached (about -70°F for butyl rubber). The brittle point is independent for extender oil composition.

Please be aware that in terms of the stiffness or modulus specification, aromatic rejuvenating oils produce recycled asphalt mixtures very typical of paving grade asphalts. This makes sense, as an aged asphalt loses aromatic oils due to oxidation. Putting back the aromatic oils produces a material quite similar to virgin asphalt.

The naphthenic and gas oil produced something quite different. There are asphalts like these in the

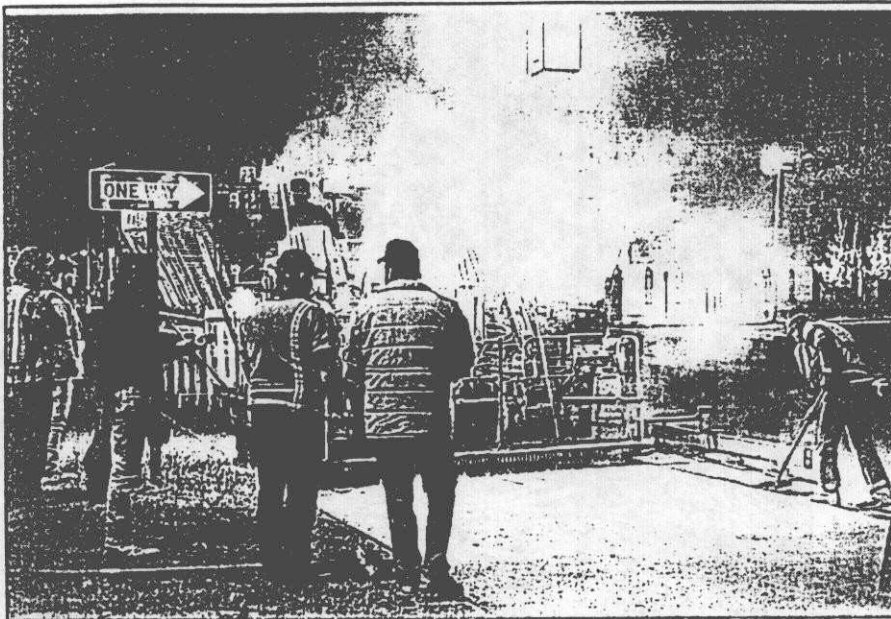
SHRP database of asphalts. So although naphthenics and paraffinics may offer improved temperature susceptibility in terms of stiffness (and this may not correlate to cracking as suggested by the phase angle results), naphthenics and paraffinics fail fatigue cracking and are expected to do poorer on the low-temperature test.

Aromatics meet the SHRP specifications, are typical of paving grade asphalts, and thus are recommended as rejuvenators of aged asphalt. Low-viscosity asphalts may or may not work; they give unpredictable results.

Cold mix recycled asphalt has an added problem towards achieving SHRP specifications. The rejuvenator may not penetrate or mix with the hard RAP particles to bring the entire binder within SHRP specifications.

However, an understanding of an oil's molecular size can help here. Aromatics, having the smallest molecular size, possess the greatest solvent and penetrating character. Those using surface treatments have already found aromatics superior for this reason. State DOTs that use aromatic rejuvenators are able to soften the RAP to at least 10,000 poise on the average mix. Those using low-viscosity asphalts are only capable of softening to at best 20,000 poise. Cold mix recycled mixtures may never reach SHRP specs, but they will come closest when an aromatic rejuvenator is used.

Finally, mention must be made of an oil's volatility. Volatility will vary depending on the refining process. Those who fear rejuvenating oils due to high volatility should be aware that two of the aromatic oils used in the study have TFOT % losses less than or equal to the two AC-5 asphalt. Also, a greater amount of the AC-5 is required to soften or to rejuvenate RAP as compared with oil. Thus more volatiles are added to the AC-5/RAP mixtures, as compared to the oil/RAP mixtures. □



A Blaw-Knox PF-510 paver places 94% recycled asphalt paving on a 3.5 mi. stretch of Gratiot Ave. (M-3) in Roseville. John Carlo Inc., Mt. Clemens, has been serving as prime contractor on the nearly \$3.2 million Michigan Dept. of Transportation project, with the RAP produced by Burnley-Marlin Builders Equipment & Supplies Inc., Detroit, a minority owned business.

Microwaved RAP put to the test in Roseville

By Guy Snyder
Editor

Roseville — Microwaved RAP may sound like something you'd watch on M-TV but a better place to discover its qualities can now be on a 3.5 mi. stretch of Gratiot Ave. (M-3). John Carlo Inc., Mt. Clemens, is putting the finishing touches on resurfacing the eight lane boulevard between I-696 northerly to 14 Mile Rd. with microwaved RAP — recycled asphalt pavement (RAP) produced through a unique procedure utilizing microwaves — under a \$3.18 million contract with the Michigan Dept. of Transportation.

The RAP being used on Gratiot Ave. is being generated by a subcontractor: Burnley-Marlin Builders Equipment & Supplies Inc., a minority owned firm based in Detroit. To produce the mix the subcontractor has been using the patented Cyclean process, under an exclusive lease arrangement with Cyclean Inc., Houston, Tex. Burnley-Marlin has been operating a portable Cyclean plant on a four acre parcel of land it's been leasing from Marsack Sand & Gravel Inc., just east of the intersection of 14 Mile Rd. and Gratiot Ave.

Overall the project has involved milling an existing 3 in. layer of old asphalt off an underlying concrete pavement that's approximately 8 to 9

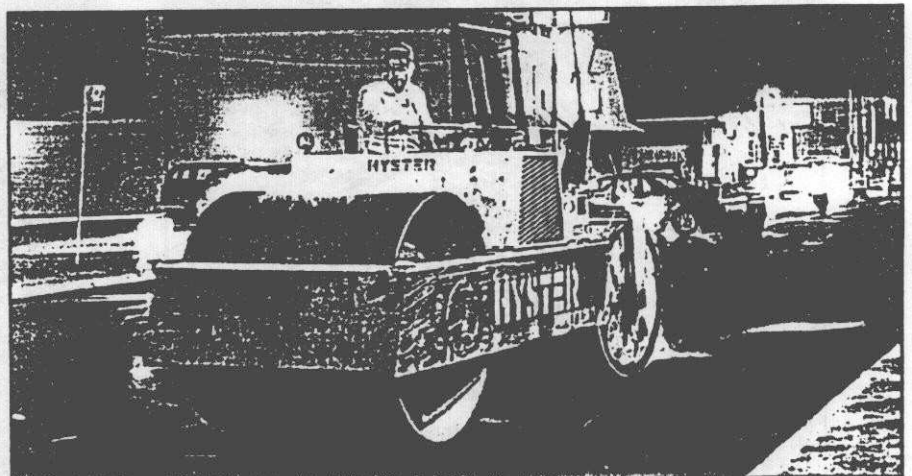
in. thick. The old asphalt has been stockpiled at Burnley-Marlin's plant for recycling when needed. After recycling the new mix has been placed in two lifts — a 170 lb. per sq. yd. wearing course covered by a 160 lb. per sq. yd. wearing course — with the vast majority of the work performed after 9 p.m. Gratiot Ave. being a major thoroughfare for metropolitan Detroit, MDOT has required crews to work into the wee hours of the morn-

ing so that the roadway can be opened by 6 a.m. for rush hour traffic. Only one lane is allowed to be closed from the dawn to starlight.

A relatively new procedure the Cyclean method for recycling asphalt pavement was evolved during the early 1980s. Cyclean Inc. was founded in 1983 by its chairman, Robert Nath, and received initial funding by venture capitalists in 1985. By 1987 the proprietary microwave based process had been developed as an approach for completely recycling asphalt in as environmentally clean a manner as possible. Investors in Cyclean include Caterpillar Venture Capital Inc., Rothschild Inc., Technology Funding Inc., New York State Business Venture Partnership, Houston Industries Inc., ZI&I Overseas N.V., Genesis Fund Ltd., and IEG Venture Partners Inc.

Richard Ford, Cyclean's executive vice president, (and a nephew of former U.S. President Gerald Ford,) told *MC&B* that microwaving asphalt had been attempted before, during the 1970s. The Cyclean method, however, combines it with other technologies that have considerably improved on the concept. Pointing out the features of Burnley-Marlin's Cyclean plant, he pointed out that its drum has special, proprietary features based on Cyclean's "Clean Flow" design that are crucial to producing RAP of consistently high quality.

Within the drum are special screw, lifter, and flight configurations. They are used in combination with special controls for gas velocity, humidity, and temperature. RAP material entering the drum is heated, by a specially shielded burner fired by either natural gas or a liquid fuel, to a temperature of about 240°F. Dried by the drum, the material is then

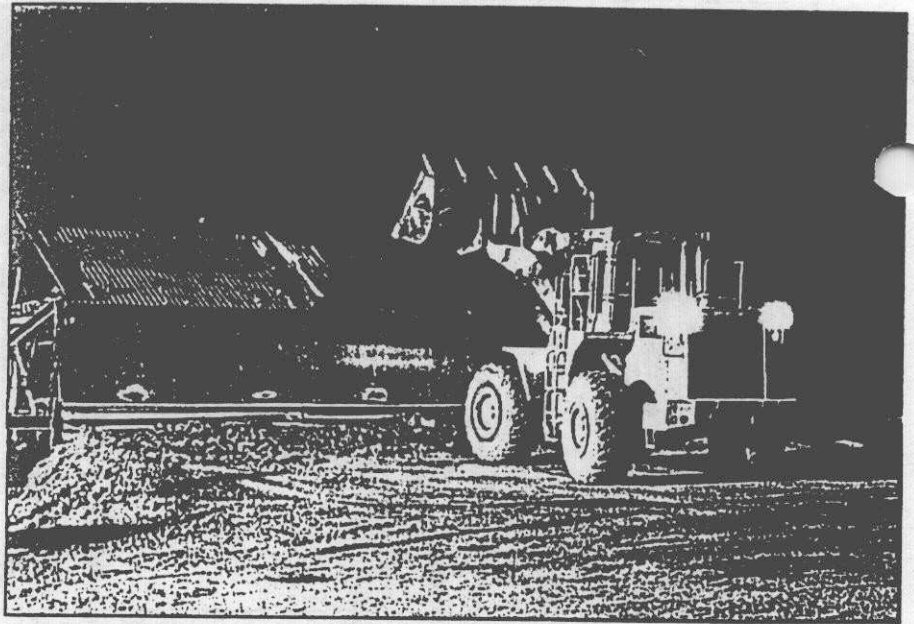


MDOT specifications called for the Gratiot Ave. RAP to be compacted to a 94-96% density. A pair of Hyster double drum static rollers were used. The RAP was placed in a 170 lb. per sq. yd. lift of leveling course followed by a 160 lb. per sq. yd. lift of wearing course.

conveyed into a continuous mix, twin shaft pugmill where a recycling agent is added (at from 1/2% to 1%) of volume. The final design temperature of approximately 300°F is achieved by microwaving it later on in the production stream.

By not initially heating the RAP in the drum to mix design temperatures, scorching of the aggregate and excessive smoking is greatly reduced, if not eliminated. Using microwaves to achieve the final mix temperature, Ford said, also greatly reduces air emissions. That's because the method takes advantage of the different physical properties of stone and the petroleum molecules that make up asphaltic cement.

"Aggregate is a material that's highly polar in nature in nature that heats (when microwaved) rapidly," Ford said, "while asphalt cement is made up of (non-polar) hydrocarbon molecules of very long length which heat up slowly." Thus, when the mix is microwaved, the aggregate responds quickly while the asphaltic cement lags behind. (You may notice a similar effect when you try to microwave different kinds of food.) Cycleclean takes advantage of this phenomena, allowing the heated aggre-

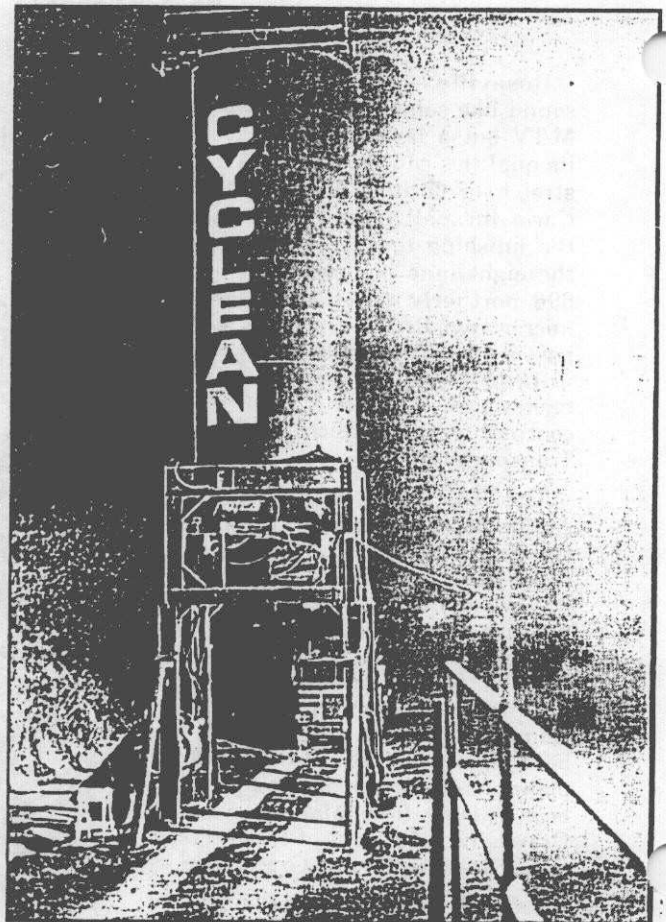
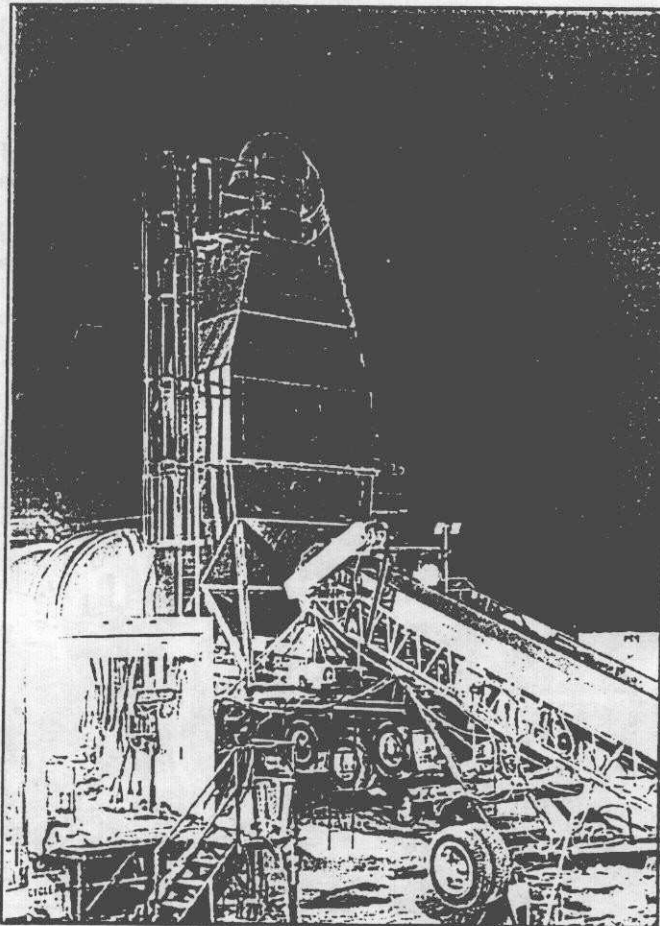


Feeding the screens of Burnley-Marlin's Cycleclean plant was this Caterpillar 966C wheel loader. Material not passing a 1/2 in. screen was routed to a crusher.

gate to heat its surrounding asphalt cement through conduction. A more even distribution of heat is thereby achieved, further reducing potential air emissions.

The microwaving is performed in an enclosed tunnel before the final

mix is conveyed to a storage silo. Reflective and absorptive shielding used with containment structures within the tunnel protect plant personnel and permit the plant to comply with all military and Federal



Located on a four acre parcel leased from Marsack Sand & Gravel Inc., Burnley-Marlin's Cycleclean plant has a rated maximum capacity of 310 tons per hour. Actual production for the Gratiot Ave. project has not exceeded 210 tph due to the high (3.7%) moisture level of the old, milled off asphalt pavement. At right, a truck waits by the plant's storage silo for another load.

Communications Commission radio frequency requirements.

"We never burn the material to begin with," Ford claimed. "We run the cleanest plant in the world." With exhaust gases taken care of by a bag-house and an exhaust oxidizing heater burner, emissions from the plant are nearly invisible. Certainly during MC&B's Oct. 6 evening visit, when Burnley-Marlin was operating the plant around 11 p.m., all that could be seen in the light of a gibbous Moon was a few threads of "water condensate white plume," also known as steam.

Test results of Cyclean's technology back up his claim. A Cyclean plant in Georgia was tested last year and found to be generating air emissions well below those tolerated within Los Angeles, Calif., basin, (as established by the South Coast Air Quality Management District), which are considered the most stringent in the world. The plant emitted only 75 lb. of carbon monoxide per day (compared to SCAQMD's limit of 550 lb.), and 4

lb. of nitrous oxide (compared to 100 lb.) Sulfur dioxide emissions were zero (compared to 150 lb.), particulates and volatile organic compounds were negligible (compared to 150 lb. and 75 lb. respectively), and lead and opacity came in at zero, (compared to 3 lb. and 20% respectively). September 1991 tests performed by Intracplan of Houten, the Netherlands, also indicated the plant could easily surpass proposed U.S. Environmental Protection Agency AP-42 standards for air quality that have yet to be enacted.

Indeed, since 1987, the city of Los Angeles, Calif., has been using the Cyclean process to recycle its old asphalt pavements. The city's Street Maintenance Division recycles 200,000 tons of asphalt yearly and, according to Greg Scottt, its general superintendent, it has been providing a consistent paving material using 100% RAP of a quality equal or better than asphalts produced solely with virgin materials.

"The recycled material is tested in the city's laboratory four times daily,"

he reported in a bylined article in the May 1991 issue of *Public Works* magazine. "The testing is the same as that for virgin asphalt; no special procedures are required. Gradation has been satisfactorily within prescribed limits. Marshall stability tests have shown sustained levels

averaging over 3200 lb. with flow averaging 15. Asphalt content level and viscosity are maintained within design limits through continuously monitoring the additive mixed in after final temperature has been achieved."

The Cyclean process was used in 1991 to produce a 90% RAP for 72 lane miles of Interstate 35E near Dallas, Tex. Last summer, the Pennsylvania Turnpike Commission was used to recycle seven miles of four lane tollway in Lancaster County. It is also being used by Dutch contractor Hollandesche Wegenbouw Zanen to produce RAP at a site at a major expressway interchange near Rotterdam.

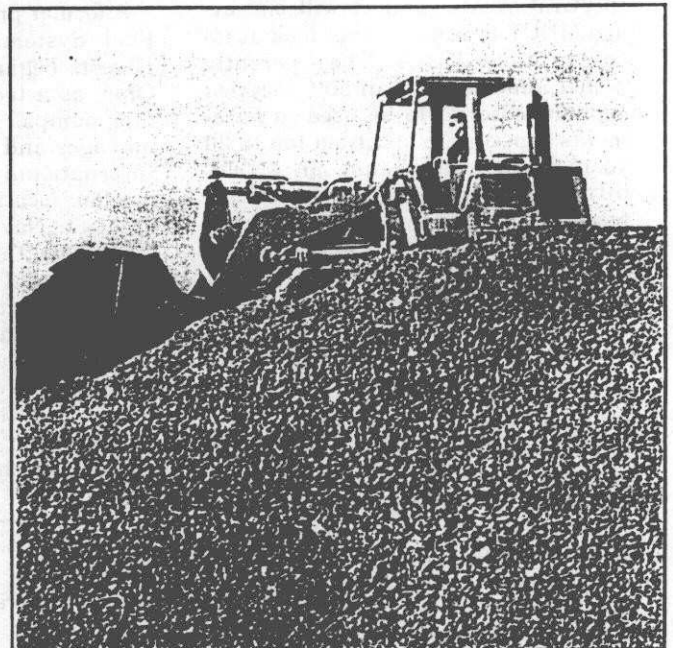
For the Gratiot Ave. project, Burnley-Marlin has geared its Cyclean plant to produce a 94% RAP. A Caterpillar 963 crawler loader is being used by the subcontractor to maintain old asphalt milled from the roadway in stockpiles at the Cyclean plant site. Feeding the old asphalt into the plants screens has been a Caterpillar 966C wheel loader.

The old asphalt has to pass a 7/8 in screen with oversized material routed to a crusher. It then proceeds through the plant as outlined above. Under ideal conditions the plant is capable of producing up to 310 tons per hour but, Burnley-Marlin's plant operator, Eddie Austin said, top production has only hit the 210 tph rate, with normal production averaging 180 tph.

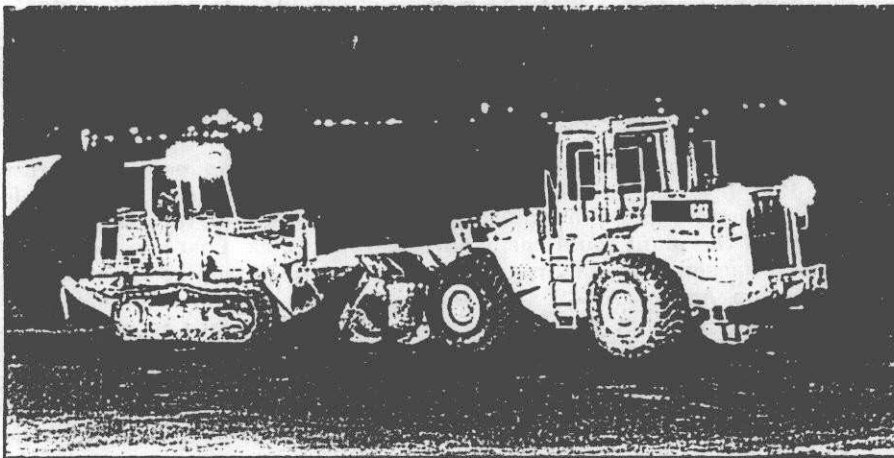
The reason for lower production, both he and Ford explained, apparently has been due to a high moisture content in the old asphalt, perhaps caused by the wet summer and fall Michigan has experienced this year.



At Burnley-Marlin's Cyclean plant last month were, from right: Eddie Austin, plant operator, and David A. Burnley, president, both with Burnley-Marlin Builders Equipment & Supplies Inc., Detroit; Leon Wenger, PE, MDOT resident engineer; and Richard Ford, executive vice president, Cyclean Inc.



Assisting with the milled off, old asphalt pavement at the Cyclean plant was this Caterpillar 963 crawler loader.



The crawler loader assists the wheel loader to get the bottom of one stockpile of milled asphalt pavement into its bucket. The Cyclean process can produce up to 100% recycled asphalt pavements.

On average, moisture content in the stockpiles has been at around the 3.7% level, requiring more drying. The plant's drum has to dry it down to a 0 to 0.1% moisture content before the new mix can be generated.

After leaving the plant, the new RAP has handled much like a virgin mix, and has been placed in a conventional manner. During MC&B's visit, prime contractor Carlo was placing the asphalt with a Blaw Knox PF-510 paver followed by a pair of Hyster dual drum static rollers. Leon Wenger, PE, MDOT's resident engineer on the project, said the project's specifications call for a final density within the 94-96% range. He said the RAP has proven to be "a fairly consistent material" on the project.

David A. Burnley, Burnley-Marlin's president, said he's hoping success in the Gratiot Ave. project will encourage MDOT to take another look at its specifications for RAP. They currently do not allow more than 50% recycled asphalt material to be used in pavements expected to last from ten to 20 years. Douglas Coleman, an MDOT bituminous engineer, said initial tests of the Gratiot Ave. pavement indicate it should perform as expected. If MDOT should allow an increase in RAP percentages, Burnley thinks his firm and its relationship with Cyclean would benefit greatly.

Established five years ago, in 1991 Burnley-Marlin enjoyed sales of \$5 million. It's current volume is at about the \$7 million per year level. When he started it, Burnley brought about 20 years experience as a construction manager for Gilbane Building Co. to his new company. Besides producing RAP, it's been handling concrete flatwork, restoration, and waterproofing projects. He described his arrangement with Cyclean as "a good opportunity."

Besides Burnley-Marlin, other subcontractors working for Carlo on the Gratiot Ave. project have included I&L Construction Co., Holt, for milling; Dependable Contractors, Mt. Clemens, for concrete flatwork, curb and gutter, and sidewalks; and Tarr's Tree Services, Troy, for tree removal. Also, P.K. Contracting Inc., Clawson, for pavement striping; Highway Services, Flat Rock, signing; and Spartan Barricading, Holt, for signs and barricades. ♦

May Day Diesel announces new management team

Traverse City — New co-managers have been announced for May Day Diesel, located at 3887 Rennie School Rd. here, consisting of a husband and wife team — Bill & Candy Roberts.

A former president of International Fuel Systems, Franklin, Ind., Bill Roberts began his career in Findlay, Ohio, as a technician building diesel fuel pumps. He went on to become manager and ultimately president of International Fuel Systems. The firm has four locations and sells diesel fuel pumps to Navistar International.

His wife, Candy Roberts, worked at International Fuel Systems, as the company's accounting and customer relations manager. So why have they moved to Traverse City? It may have something to do with the old saw Traverse City residents enjoy repeating to strangers: "A view of the bay is worth twice the pay."

Practical men, who believe themselves to be exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back — J.M. Keynes.

"My wife, Candy, and I wanted to work in a small business environment and enjoy the lifestyle of a smaller community that has a lot to offer," Bill Roberts explained. Work together, the husband and wife team brings 24 years of experience to their new jobs.

"We truly believe we can grow May Day Diesel into the foremost northern Michigan diesel fuel pump remanufacturer by providing product expertise, competitive pricing, and customer satisfaction," Candy Roberts said. "That's why we're here."

Two school buildings set to undergo renovations

Breckenridge — Breckenridge Community Schools has plans for a \$5.5 million expansion of both Breckenridge High and East Elementary schools.

The architectural firm handling the project is Robert Lee Wold & Assoc. Inc. of Grand Rapids.

Renovations at the high school would include new classrooms, bathrooms, a computer laboratory, gymnasium, and administrative areas. The addition would house primarily middle school students, with the intent of separating them more from senior high school students..

District officials also have plans to abandon West Elementary School and renovate East Elementary, adding three new wings to its existing structure.

The elementary school would gain four rooms for special education classes and special services, an all purpose room for use as both cafeteria and auditorium, and new classrooms.

A bond election for financing the work has tentatively been slated for March 1993.

ENGA hires Wm. Donner as its senior group leader

Troy — William E. Donner Jr. has joined Ellis/Naeyaert/Genheimer Assoc. Inc. as a senior group leader.

Donner, who earned his bachelor of science degree in electrical engineering from Lawrence Technological University, has been involved in various facets of electrical power system planning, design, and construction for the past 25 years. His project background includes facilities for automotive, military, aircraft, and aerospace clients.

He is currently leading ENGA's electrical design of a new Health Physics facility for the U.S. Dept. of Energy and a CCTV security system to be installed at the University of Michigan Hospital in Ann Arbor.