Dense cold mixes: Preservation of county roads

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1- Introduction

Emulsion cold mixes are widely used in France and southern Europe for decades. But beside “emulsion cold mixes” one can find many different products. The topic of this paper is “dense cold mixes” for wearing course and can also be called “cold asphalt concrete”.
This particular product is developed now for 20 years in France and begins to spray throughout Europe and especially Eastern Europe where easy to use and cheap techniques are really popular.

According to USIRF, a definition of this product could be :
“Emulsion mix asphalt, not or shortly storable (for use in 24 hours and never more than 48 hours), for use as wearing course and constituted of selected aggregates totally coated with binder”.
As this product could be the result of many ways of working, this definition can be completed by :
“A fraction of the aggregates could be precoated either by emulsion or by hot asphalt binder prior to the final coating. The final coating is always done using emulsion.”

This kind of asphalt product is mainly used for pavement preservation. It is particularly useful for resurfacing and reinforcement of distressed surface pavement where it can be laid in a single operation without need for reprofiling.

Thanks to their flexibility and self-healing capability, dense cold mixes provide a very interesting solution for rehabilitation and improvement of very flexible pavements with high deflection. They are particularly useful for rural areas of low to medium traffic volume roads.

2- Laboratory study

This type of emulsion cold mix is not commonly used in the USA but there are a lot of articles and technical data available from AEMA on this topic.

It is important to recall that a complete laboratory study is essential to make a good dense cold mix and especially the step consisting of adapting the emulsion to the aggregates used.

Principle steps of this laboratory study as defined in the optel project are the followings:

- Step 1: Definition of aggregate gradation curve and properties
    - Adaptation of gradation curve
    - Fine particles surface area measurement
    - Aggregate reactivity in acidic medium
- Step 2: Definition of a minimum total water content
    - Essentially for coating purpose

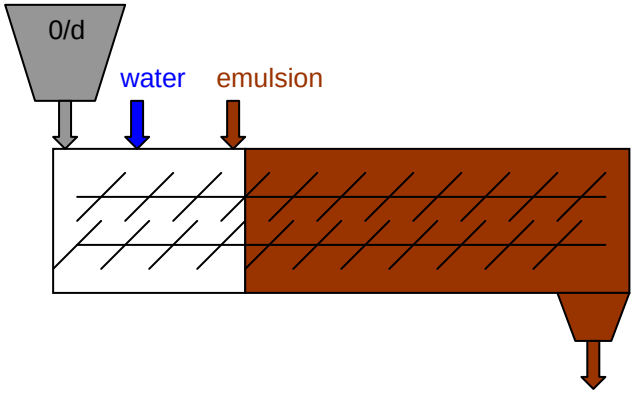
- Step 3: Definition of a total emulsifier content
    - Essentially for mix time tuning and depending on the way of working of the company
- Step 4: pH adjustment (and acid type)
    - As a function of aggregate properties
- Step 5: Definition of a minimum emulsion content
    - Could be calculated by comparison of asphalt droplets surface area in the emulsion and aggregate surface area
- Step 6: Final composition optimized considering mechanical properties of the mix
    - Workability at short time
    - Mechanical and moisture resistance after ageing

It is of course not necessary to achieve all these steps to design the cold mix but the more is the better. Adjusting emulsion to aggregates to obtain good mixing time and coating is the key point.

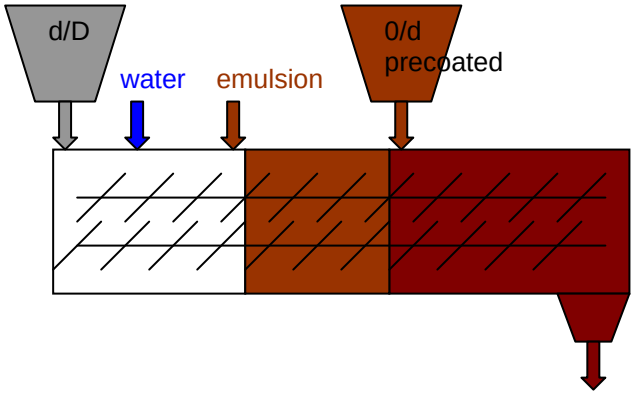
3- Industrial production

Another critical point to make good dense cold mix for wearing courses is the mix plant used. With a standard cold mix plant it is very difficult to obtain a complete coating of coarse aggregates. To obtain better results, several solutions have been tested and generally patented by road construction companies and here are some process examples:

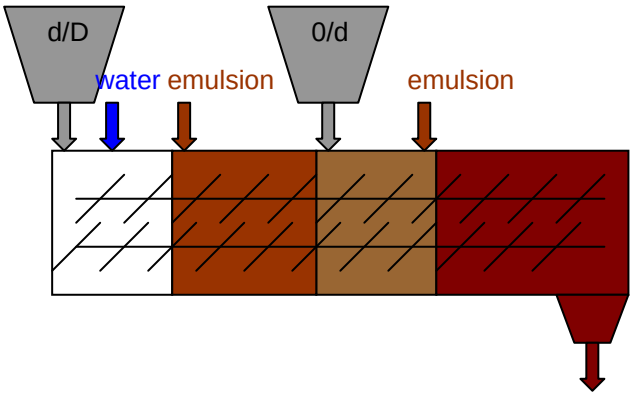
Standard process:



Process with precoated sand fraction:



Process with sequential coating:



Other combinations are of course possible.
On all these process, it can be usefull to use additives in the water, in the emulsion or even to treat one specific aggregate fraction before feeding the pugmill. Examples of process additives can be found in Stabiram CM range from CECA.

In order to obtain a good final aspect and surface smoothness, dense cold mix must be laid with a finisher and compacted with a steel roller (vibration can be used shortly at the begining). Completing the compaction with a rubber-tired roller is often usefull.

4- Jobsites examples

Here are some examples of mix design and jobsites done in France and eastern Europe in these last 10 years :

1/ New construction in Britany (France, 2002)

2 layers 4 inches thick with grave emulsion for subbase layers.

- 0/14 mm aggregates (D> ½ inch)
- 4.2% asphalt PG 64-22 (65% asphalt emulsion)

1 layer 2.5 inches thick with dense cold mix as wearing course.

- 0/10 mm aggregates (D> 3/8 inch)
- 5.7% asphalt PG 64-22 (65% asphalt emulsion)
- Use of compacting aid additive Stabiram CM508 (0.3%)

Good resistance to heavy loads traffic (quarry road) despite of high void content (15% after one month).

2/ Preservation of pavement in an industrial park in rural area (south-west of France, 2005)

Deep flashes, corrugations and high deflection.
Numerous edge cracking.

Reprofiling and resurfacing with 2 layers of dense cold mix (0/10 mm).

- Sequential coating with delayed sand introduction
- 8.8% emulsion (65% asphalt PG 64-22)

Very good resistance and aspect after 3 years under traffic. Second part of the job ordered this year.
3/ Jobsite on rural road in Bielorussia (2007)

Mix production on mobile plant.

Laid down with a finisher and compacted with a mixed compactor

Still good aspect after hard winter time under traffic.

5- Conclusion

Dense cold mix is a very convenient product for preservation of flexible pavement.
It is cheap, easy to use and environmentally friendly.
It allows making in one job what needs generally a two steps process to be achieved.
There is no need for closing the road when working as reopening to traffic can be done just after compaction.
The only constraint is the need for a complete and accurate laboratory study before going to the jobsite but this is a need for every kind of mix.

Bibliography

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