

Why is pavement recycling a preferred pavement rehabilitation approach

Presentation at the seminar on recycling techniques organised by the PIARC Committee C7/8, Road Pavements and the Road And Bridge Research Institute of Poland. Warsaw, October 10th and 11th.

Ir. Jan Th. van der Zwan, Road and Hydraulic Engineering Division, Public Works Department, Ministry of Transport, Public works and Watermanagement, The Netherlands. Leader of subgroup 5, Pavement recycling and rehabilitation, technical recommendations.

Introduction

It is with pleasure that I will tell you something about recycling in general and I will try to answer the question why pavement recycling is a preferred pavement rehabilitation approach. I will not discuss technical details of recycling. In the next sessions you will be informed about 3 different techniques for recycling that can be used. Of course there are also other recycling techniques and recycled materials that will not be discussed in this seminar. It might be that we will pay attention to other techniques and materials in the next working plan of the technical committee of PIARC.

What can you expect of me. I would like to present you some views on recycling that might be beneficial for you.

Maybe in your country you already have experience with recycling, maybe not. I can tell you that I have just about 25 years experience with recycling. Not only with the technical aspects but also even more with the strategic and political issues related to recycling.

My name is Jan van der Zwan as you've heard in the introduction. I just want to tell you something about my background. That will make it easier for you to understand my approach. I work for the government in the Netherlands. As you might know, the Netherlands is a densely populated and relatively affluent country. This means that there are many people living per surface unit who all have their demands for space and comfort. In addition, there is a high level of activity in many economic sectors. All these factors are accompanied by a continual need for the use of the limited space available in the Netherlands.

Every year, very large quantities of land are used for dumping waste on the one hand, and for extracting surface minerals such as gravel, sand, clay, and limestone, on the other hand. The realisation that this way cannot be continued any longer is deeply anchored in our society. The closing of material cycles, resulting in the need to dump less, and less exhaustion of non-renewable raw materials, is a consequence of that. That is the reason that we in the Netherlands for more than 25 years are focussing on sustainable development. Recycling in road construction is one of the key issues. I do realise that we are also in a position that we can afford this.

Ladies and gentlemen, it is therefore that I will give this presentation with some hesitation. Not because I do not want to do so, but more because I realise that I speak to you based on the knowledge and experience that I have. Our experience is also based on the political issues my government has. And like I said, compared to many of your countries, we are a wealthy country. This means that we can afford to do things that might not be possible for your country. This is not only true for developing and transit countries, also within western Europe I think that my country has a leading role in recycling and sustainable development applied for road construction.

Reasons to recycle

There are many reasons why you should recycle.

Technical reasons:

The materials have specific properties and a good performance. You can think of some kinds of cements. But also of bitumen what once was a waste product.

Financial reasons:

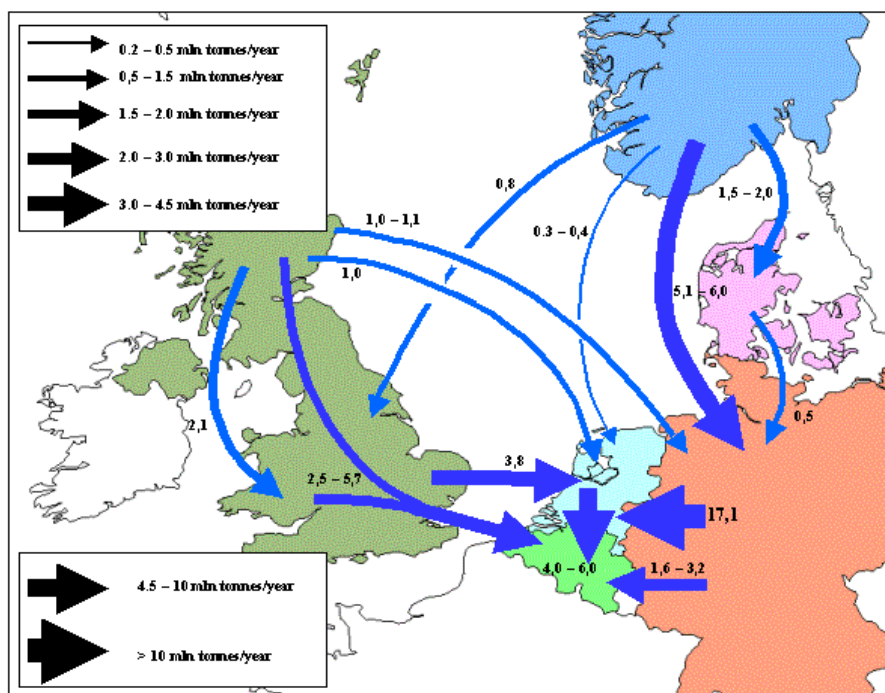
The project costs are lower when you apply recycling. Of course, one has to take into account the life cycle costs rather than the direct project costs.

Environmental reasons:

Recycling decreases the need for new building materials and the need for scarce dumping sites. Also recycling could mean that energy consumption is decreased and there are lower emissions of hazardous materials

Shortage of raw building materials and a shortage of valuable land for dumping is one of the main reasons for the stimulation of recycling in Western Europe.

Shortage means that import is taken place. In this figure some movements of raw building materials between some European countries can be seen. It will become more and more difficult in the future to excavate building materials so the pressure for reuse and recycling also will increase.



Transport of mineral aggregates in a part of Europe due to a shortage

In practice the reason to recycle is a balance between all these three factors. Factors are interrelated. Properties determine the performance of materials and therewith the price. Environmental values also can be priced. Where the balance lies is depending on local situations. I will explain this several times in my presentation.

Therefore, do not expect from me that I will tell you that you should recycle. That recycling in a certain way is the best for sustainable development. I will not do so. I will try to explain to

you that there might be a lot of factors that drive recycling. Which factors are relevant for your country, I can and will not say. It might be that based on political issues economy is more important than sustainable development. It is not to me to criticize that. It is up to you and your country to decide which goals you would like to achieve. What I hope today and tomorrow is that you get enthusiastic about the technical possibilities for recycling and that you go home with a lot of plans how to get things implemented in your country. I hope that based on the information you receive these days and the contacts you make, you also will use the experience in the different countries and that you will not invent the wheel again. It is much easier to use wheels invented elsewhere. Better a stolen perfect idea, than a wrong one invented by you. Take my word for it.

What I want to make clear is that recycling is more than the technologies presented in this seminar. It is dealing with political issues, with economy, with market and market acceptance. One remark, I've found out that in general the technical issues are easy to solve compared to political issues. Nevertheless we as technicians seem to focus on technical problems and we neglect the issues that are really important for the success of recycling. And that are the issues like I said, related to policy, economy and market acceptance. I will explain that more in my presentation.

No simple answers

Is recycling simple? On a strategic level I do sometimes doubt it. Socrates, the great Greek philosopher, already said, the only thing I know is that in fact I do not know anything at all. The same applies to me. The more I know about recycling, the more I know about all the issues addressed by recycling, the more I know that life is not simple. There is not one simple answer. The answer is based on local situations, but also on the view of men.

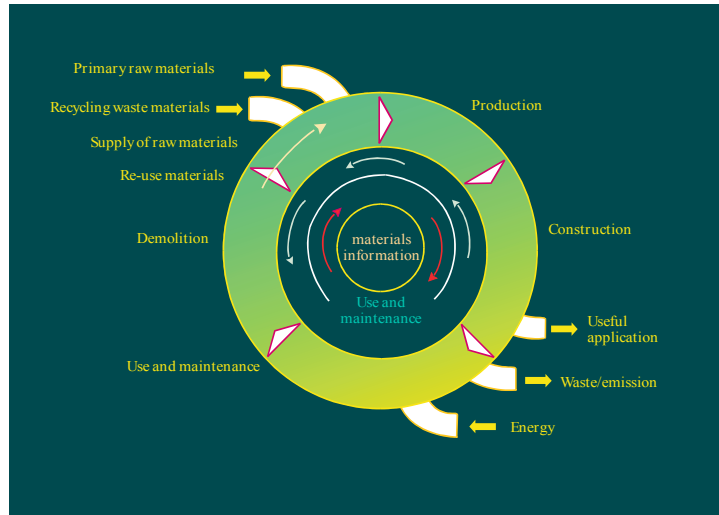
If you have different goals, than also the solutions will be different.

In this seminar you will be confronted with three different ways of recycling. Is one way better than the other, for which solution do we have to choose? Let me say ladies and gentlemen, that we will not give you the answer. If the answer would have been simple, than we would not have prepared three guidelines but only one. There is not one answer. The choice to make is depending on the local situation. We can use all kinds of models as life cycle analyses, life cycle costing, and many others to calculate which is the best way of road construction, use of materials, recycling. The best way could mean the best technical option, cheapest, or the most sustainable. For instance, is hot mix recycling of asphalt to be preferred above in situ recycling with cement? Or is in situ recycling with emulsion a more sustainable approach? You will have to decide, not only on sustainable issues, but also on the combination of technical issues, economical issues and environmental issues realising that your choice has implications for the next decennia.

This means that there is a tight relation between the technical aspects of recycling and the political issues in your country. You have to realise that in order to make the right decisions.

In the next part of my presentation I will deal with the following issues. What is recycling, why should you recycle, is recycling feasible, what is the role of politics, what are success factors?

What is recycling.



The building cycle

The best way to illustrate this is by using this figure. This figure symbolises the building cycle. You can see that there is an input of raw materials in order to built the road, it is being used and after it fulfils its purpose the road is maintained and waste materials are produced. The ideal situation, ladies and gentlemen is that you close the cycle. That means that the materials used in the road in time will be recycled and that you rebuild the road again. There is no waste going out, nor new materials are needed to go in. In that situation the road industry takes care of its own waste. The word recycling might be used for those situations that the material properties remain the same. For instance asphalt recycled in asphalt, concrete in concrete. For other situations where the material properties are changed I myself like the word reuse better. For instance when you apply concrete rubble in an unbound base course. But if you want to call that recycling to, you have my blessing. What is important is that you apply road construction materials again and again. One of the messages that I would like to give to you is design for recycling. That is one of the benefits of the cycle. It makes very clear visible that you will always be confronted with the decisions that you made in the design period. If you choose materials that cannot be recycled later, you will be confronted with that. This means that you will have a flow of materials leaving the system that you will have to dump somewhere. With all your decisions you have to take in mind you have to design in fact for recycling.

The three techniques presented in this seminar all use the material in the road to make new construction materials for the road. With hot mix recycling you transfer old asphalt in new asphalt with the same properties, the two in situ techniques which will be presented use a new binder to make a new product with specific properties from the materials present in the old road.

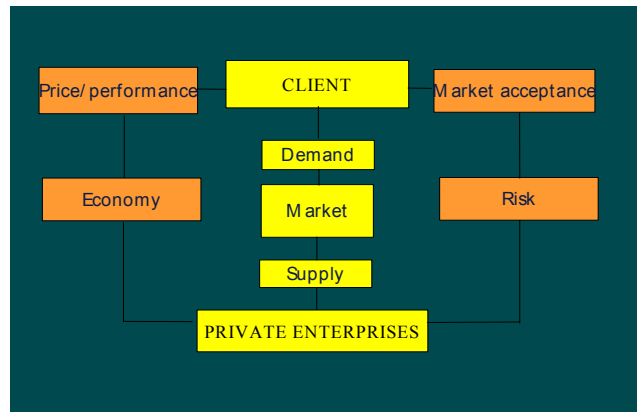
I hope it is obvious for you that financial aspects determine the mass flows. If dumping is cheap you do not have to worry so much about this waste. I will deal with these financial aspects more in detail later.

Please take in mind that the situation in 30 years might be very different from now and you will not be able to dump materials so easy. If you look around you can see what your foreland will be. Look at countries as Japan, Germany, and the Netherlands where it is not possible anymore to dump reusable materials. This way of thinking will in time also be implied in your country, I'm sure about that. When you have to make decisions now, think ahead.

Why should you recycle?

Being able to recycle is one, but that does not mean that you should recycle. Why should you recycle? Like I said in the beginning of my presentation, the answer is not simple. It depends on the criteria you want to apply. Like I said I will not address the question of recycling only from a sustainable angle; that would be too easy. I would like to give the practical approach. The question is why should you in your country recycle. The most important criterion, ladies and gentlemen, is money, costs, and the price of the project. For let's be realistic. Neither the client nor the contractor in general will be in a position to spend more money than necessary for the project.

I could point out that recycling is needed for future generations because otherwise we will confront them with problems caused by us. That is the idealistic approach. But like we say, ideals do not pay the price of the project. In practice it are the costs that determine if recycling will be applied.



No recycling without a market

But costs means that some one wants to buy and another one wants to sell.

In general words, there has to be a market. Without supply and without demand there will be no market. There are some preconditions, I name two. Market acceptance determines the risk for the entrepreneur and is important for the success of his product. The price performance ratio determines the market changes.

If I look at it from a technical point of view, you might say that recycling is a good choice when you get good value for money. That means that recycling must be cheaper than using only virgin materials. And that, ladies and gentlemen, is one of the key issues for the success of recycling.

Cost aspects of recycling

For what are the costs of recycling? When is recycling attractive from an economical site?

You could say that there are different cost-elements involved. One of the first is the technical value of the recycled material. If a recycled material is used, the construction engineer should have to be able to calculate the thickness of the road based on the traffic that will pass during the lifetime of the road, taking into account the climatically conditions and the degradation models for the materials. The relative mechanical properties of a recycled product determine the price it can have compared to normally used materials. A very simple example, if a

recycled material has to be applied in a twice as thick layer to have the same bearing capacity, it is obvious that the price may never exceed half the price of the competitive material.

Remember that recycling, especially in the beginning is a substitution market. The recycled product has to compete with traditionally used materials. Only in very specific situations a recycled material has such specific properties that fills a niche in the market.

But the techniques we present these two days give materials with properties that also can be derived using new materials. So if you want to have a change in the market the price/value ratio of the recycled product should be at least equal compared with new materials.

You could ask is that a good approach. For the price of recycling and recycled products will be determent by the processing costs, the fixed and variable costs of the technique.

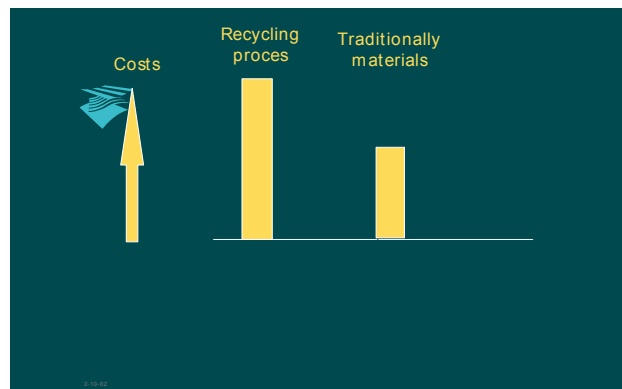
Those are the real costs that are important for an entrepreneur when he is considering starting a business in recycling. He has to invest in a technology, has to educate his staff, has to invest in quality control, and has to try to conquer a market. How many tons or how many square meters can he handle in a year, what does that mean for his fixed costs etc? It might be that the real costs for a contractor are higher than the price he can ask in a competitive market.

These are relevant questions for an entrepreneur in order to decide whether he will invest in a technology.

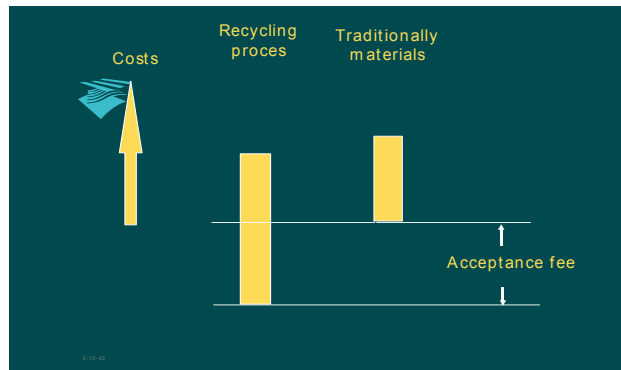
Influence of politics

In general this brings us to the role and the importance of politics. A recycling process is not always economic feasible. Like I said, in order to be able to decide on a project level if you want to recycle, you need a recycling industry. Entrepreneurs should be willing to invest. The economy of the recycling process is a one of the decisive factors as I explained.

There is where a government has a decisive influence. I would like to explain this by giving you a simple example



Costs of recycling are not competitive with traditionally materials



A negative value for to be recycled materials changes the market possibilities

If you look at a certain recycling process you can, based on the investments to make, the possible market, the exploitation costs etc determine what is the price you have to ask for your product. This price might be higher than the market price for competitive products. The conclusion should be that recycling is not cost effective. In this example in order to be competitive you can do two things, raise the price for the conventional materials or decrease the price for the recycled product. Both possibilities are for instance being applied. Raising the price is possible by charging taxes on raw materials, but in general this is not the most effective way. A good way is to make the discharge of waste materials expensive. This can be done by introducing taxes on the dumping of waste materials, or even to forbid the dumping of reusable materials. If this is done the entrepreneur can use the negative value of the waste materials to ask an acceptance fee for the incoming materials. This gives him the possibility to ask competitive prices for the product. And provided that there is enough competition, you get the best price possible.

I hope I made clear that the government has the possibility to influence the economy of recycling processes. If they will not consider this it is possible that a lot of recycling will not get started, despite the technical possibilities. In those countries where recycling is a success, the government has a political intention to recycle and uses different instruments to influence the market.

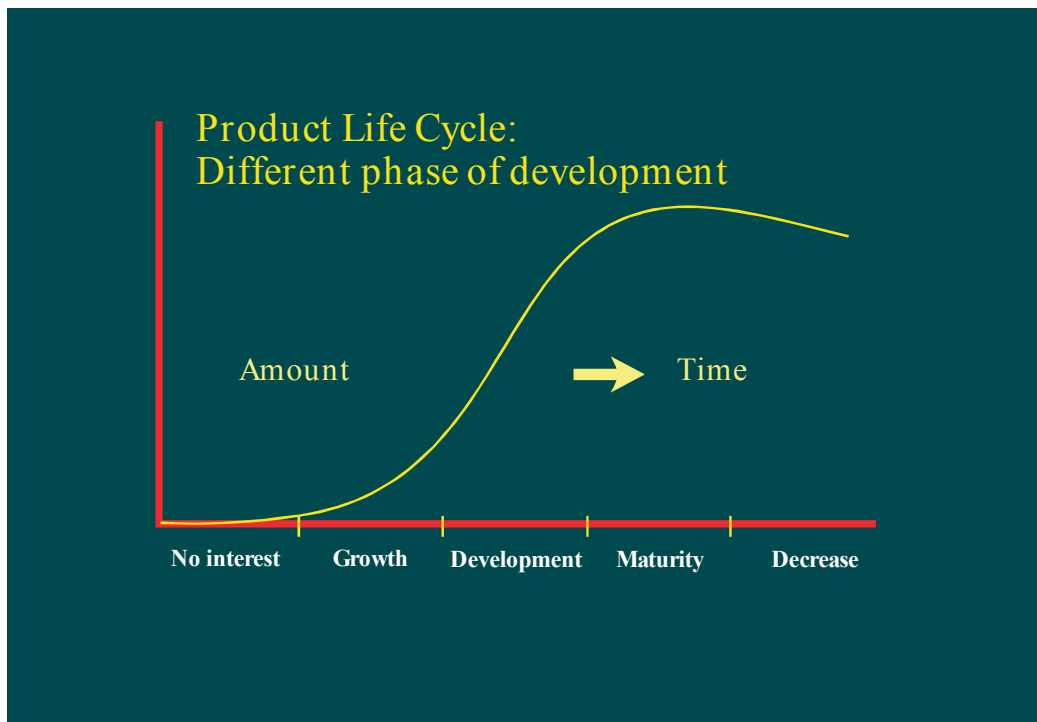
This brings us back at the beginning of my presentation where I mentioned that the hard issues to deal with are not the technical ones, but the political ones. If you have a government with a policy aiming at recycling then it is possible based on the goals given in that policy to create those conditions that favour recycling and will make it beneficial.

Life cycle approach

Is this enough? No ladies and gentlemen, this is not enough. There are in general more issues related to recycling and to get recycling successful.

Getting recycling started is not different from putting a new product or technique on the market.

It is good to realise that also recycling techniques obey general rules. One of those rules is that they also have a Product Life Cycle. In such a life cycle you can distinguish 5 phases. Namely: No interest, development, growth, maturity, and decline/decrease.



Life Cycle for products

In the first phase there is no interest at all. In the second phase you can see that there is technology development, that research is taken place and that test and demonstration projects are the beginning of market introduction

After that more clients will get enthusiastic, provided the results are good, and the number of projects will increase.

In a mature situation there is general acceptance by clients. This often is leading to love of ease. Finally there is a decline caused by changes in the market, competition, new techniques, other views etc.

You can very easy pinpoint the most important obstructions in each phase. I will not mention all but name some. I already mentioned the financial aspects, those will be clear. But do not forget the lack of technical standards, a fluctuating quality, especially in the beginning. And very important the reluctance of clients to use what first will be named secondary materials. Why should I accept secondary materials when I also can get new materials, especially if it is not cheaper.

One of the things that I've learnt is that our market is conservative. Both clients and contractors are not so keen on new techniques. One of the reasons is that we are afraid for the long time behaviour. With traditional materials we know what to expect, but do we really get value for money with new materials?

You are a lucky audience. You get from us success stories. You do not have to invent the wheel again. The technologies that will be presented today and tomorrow have, one more then the other, proven themselves. This means that it must be easier for you to apply those techniques because you can refer to experiences elsewhere. Nevertheless it is necessary to develop a market in your country.

Success factors

We have found out in our country that there are a couple of success factors for a successful introduction of new technologies for recycling.

You can distinguish between success factors for the government and for private industry. In my philosophy you need both. Remember that the introduction of a new technique costs money. If you are asking an entrepreneur to invest, they will make sure that there will be a market for the new technology. This also means that your policy must be unambiguous. It takes time for an entrepreneur to have his return of investment. If you change your policy within that timeframe it is the entrepreneur who will suffer the loss.

If a government wants to stimulate recycling it is very important that it sets straight and clear goals. They have to set the preconditions for recycling and very important, there where recycling is not feasible, to influence the economy of the market for the recycling process like I said earlier.

Also the government should demonstrate an exemplary behaviour. Invest in recycling, not only in the research, but also in making standards, contract regulations and they have to provide the possibilities for test and demonstration projects. Also the government should make very clear what is and what is not allowed. Especially environmental conditions and regulations can be decisive. And it helps very much if the government is also a problem owner.

For private industry the success factors are:

Have a very active sales policy. It is a substitution market and you have to convince clients of the advantages of your technique. Work together with the government. You need them and they need you. Invest in quality improvement and certification. In my country we had a period when we knew more of these recycled materials than we knew of the traditional materials. And when possible, find specific markets.

Conclusions

Why is pavement recycling a preferred pavement rehabilitation approach.

I hope I did make it clear that there is not one simple answer. If you take into consideration the use of valuable materials that otherwise would have been dumped, there is no question that pavement recycling in general is a good approach. Nevertheless, it is the economy that drives this kind of recycling process and road construction. This means that on the one hand recycled products should have properties that enable a road engineer to design a road that will fulfil the functional demands put forward to a road. But not only these demands have to be met, this should also be cost effective compared to other rehabilitation techniques. Whether this is a fact is depending on a lot of factors. The costs for new materials, transport costs, the possibilities and prices for getting rid of old pavement materials and the costs of the recycling technique are determining the economic feasibility of the recycling process. Whether this means that a certain recycling technique has a chance to be accepted in your country, only you can tell.

For an entrepreneur it is necessary to a market feasibility study. If those preconditions in favour of recycling are not met, then, despite the technical possibilities of the process, recycling will not start.

It is the government who, based on political goals, can influence the market.

In my opinion, pavement recycling is to be preferred; whether it will be preferred depends on the overall costs.

Ladies and gentlemen, so far my introduction. In the next sessions you will be informed about the technical aspects. You will find out that there are proven technologies. When you go home investigate the possibilities within your country.

It's now up to you.