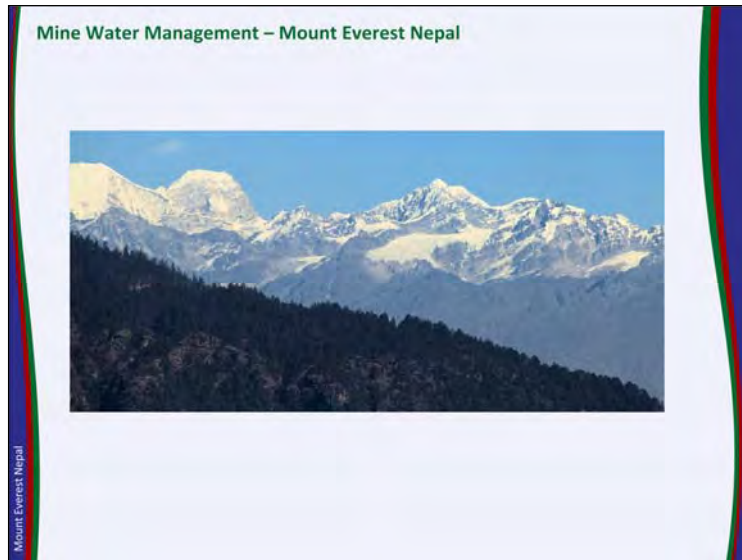


Ladies and Gentlemen,

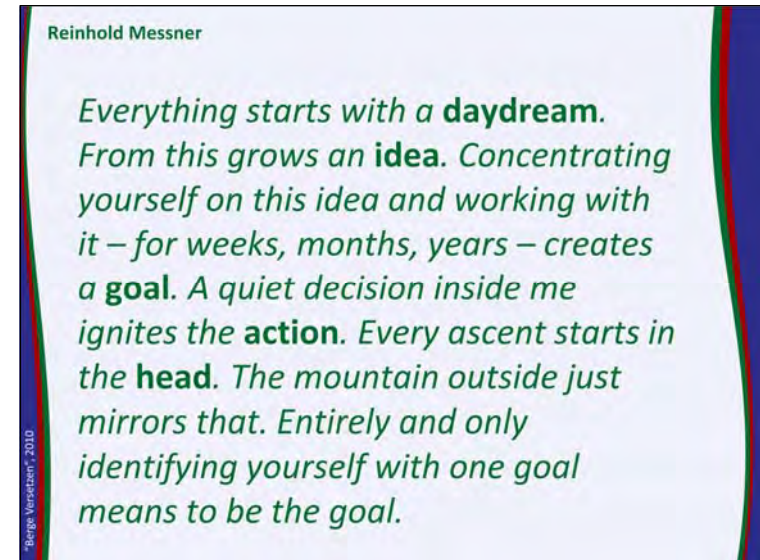


When was the last time that you stayed a whole day in bed, just relaxing, just for fun?



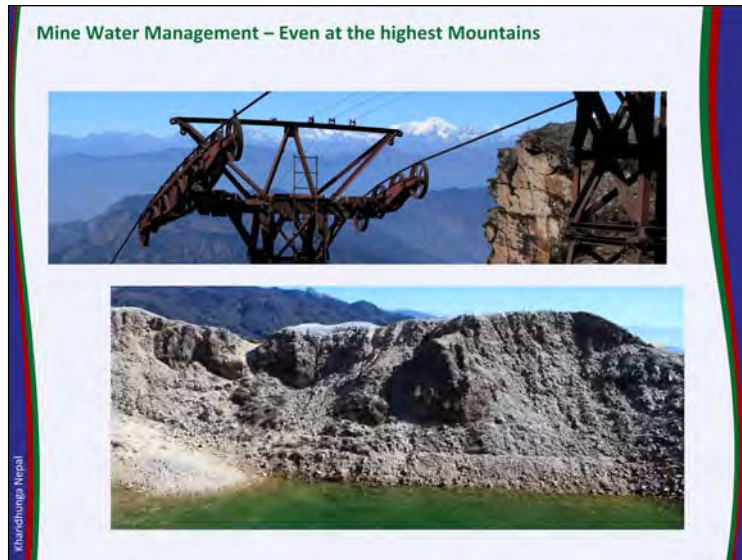
While you think about this question, let me talk about mine water management.

Reinhold Messner, a well-known mountain climber says:



Everything starts with a daydream. From this grows an idea. Concentrating yourself on this idea and working with it – for weeks, months, years – creates a goal. A quiet decision inside me ignites the action. Every ascent starts in the head. The mountain outside just mirrors that. Entirely and only identifying yourself with one goal means to be the goal.

Where, ladies and gentlemen, did you see the mine water management in this slide?



It is hidden. Do you want me to go back?

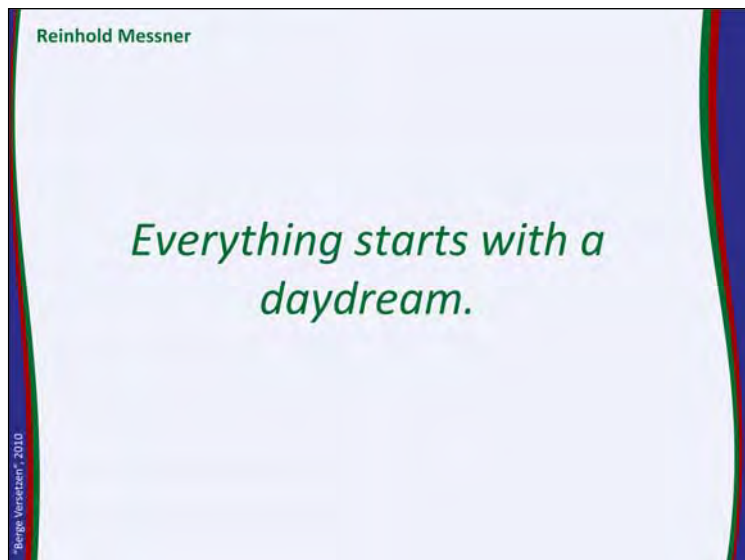
Mine water management is in your head. It must be in your head if we want to go a step forward in mine water management.

What are we currently doing? We are treating mine water with a technology that is decades old.



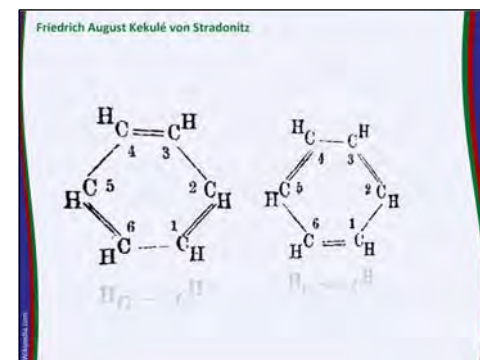
If you had a car that old we would call it an old-timer – OK. We are using old-timers to treat mine water at numerous active and abandoned mines. OK. You might love old-timers – but are they efficient from an environmental or energy point of view?

Let's go back to Reinhold Messner.



Everything starts with a daydream.

Do you know how the chemical structure of benzene was found? The man who found the structure was the German Friedrich August Kekulé von Stradonitz while he fell asleep in a London coach in summer 1855! He wrote:



During my time in London I lived for quite a while in Clapham Road, near the Common. However, I frequently spent my evenings at the home of my friend Hugo Müller in Islington, at the opposite end of the metropolis. We spoke of many things, but mostly of our beloved chemistry. One lovely summer day I rode once more, by the last omnibus, through the now deserted streets of the otherwise so lively city, "outside", on the upper deck of the omnibus, as usual. I sank into reveries. The atoms began to gambol before my eyes. I had always before seen them in motion, these tiny creatures, but I had never succeeded in discerning the nature of their motion. This time I saw how two of the smaller ones frequently paired off; how larger ones seized two small ones, how still larger ones held three and even four of the tiny atoms together, and how they all moved in a whirling dance. I saw how the larger ones formed a line, and dragged the smaller ones along only at the end of the chain. I saw what the venerable Kopp, my honored teacher and friend, so charmingly depicted for us in his "Molekularwelt", but I saw it long before him. The cry of the conductor, "Clapham Road!", awakened me from my reveries, but I spent part of the night committing at least sketches of these dream figures to paper. This was the birth of the structure theory.

And you can see them on this slide.

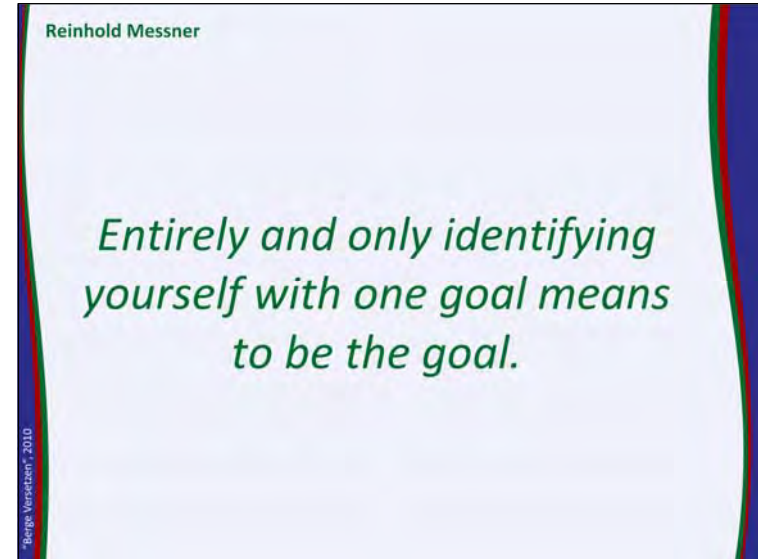
It was a dream, ladies and gentlemen, a dream that revealed the most important structure in organic chemistry!

So let's come back to my first question.



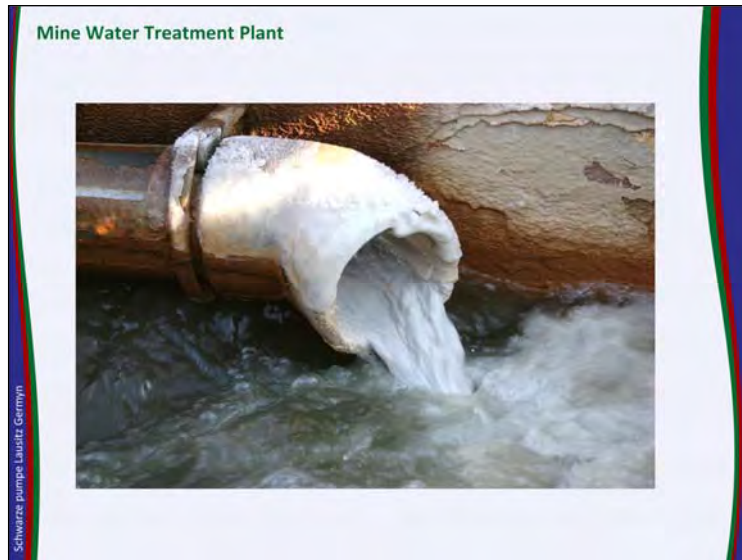
When was the last time that you stayed a whole day in bed, just relaxing, just for fun?

When was the last time, you had the opportunity to just work on one idea – such as Kekulé?



Entirely and only identifying yourself with one goal means to be the goal.

That's what Messner says.



Let's come back to mine water management.

When was the last *REAL* innovation, or if you prefer, breakthrough in mine water management? I mean a real one?

I will tell you: it was in 1969 and published the year later by Kostenbader and Haines!

It was 43 years ago! 43 years!



Who of you was born in 1969? Imagine nothing really happened in mine water management since you were born. In 1969 and 1970 we had the last real paradigm change in mine water management.

In the PC industry, major innovations happen every five years! The car industry gets $\frac{2}{3}$ of all innovation awards that are awarded every year. We should model ourselves on them and their success.

What happened in 1969 and 1970

- Man landed on moon
- The first flight of the Concorde aeroplane
- It was the birth year of the Internet
- Douglas Engelbart patents the computer mouse
- The genome of the first organism, *Escherichia coli* was isolated
- Samuel Beckett and Alexander Issajewitsch Solschenizyn got the Noble Price for literature, Max Delbrück for Medicine and Luis Federico Leloir for Chemistry
- The Beatles played the last time together
- The Woodstock festival took place
- Mercedes Benz presented the experimental car C 111

What else happened in 1969 and 1970?

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The Beatles played the last time together

The Woodstock festival took place

Mercedes Benz presented the experimental car C 111

Bed Day



Well, Ladies and Gentlemen, let's come back to your day in bed.

Who of you had a heart attack in the last couple of years?

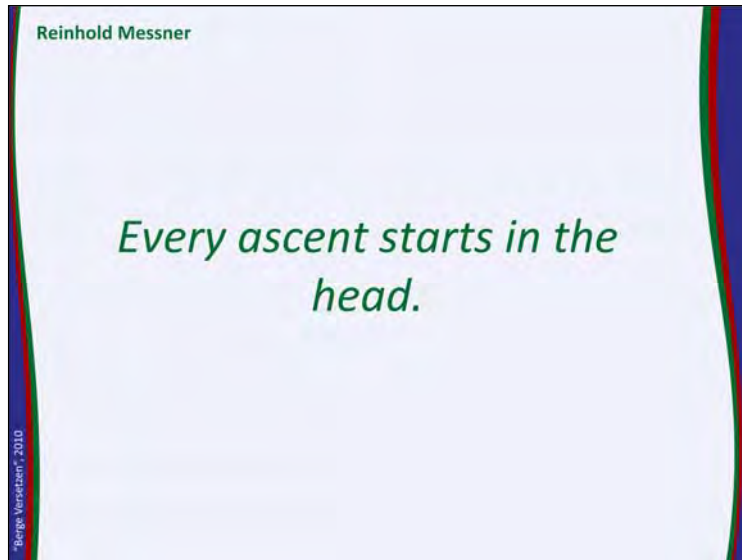
Who of you had a stroke in the last couple of years?

Who of you is suffering from the burn-out syndrome?

Who of you uses the sentence "I don't have time" too often?

Who of you works 60 hours and more weekly?

When did you have the last real holiday?



Every ascent starts in the head says Reinhold Messner.

But how can you start an ascent if your head is blocked – blocked between your smartphone, laptop, telephone, project meetings, family, proposals, writing papers, and from time to time a cup of coffee?

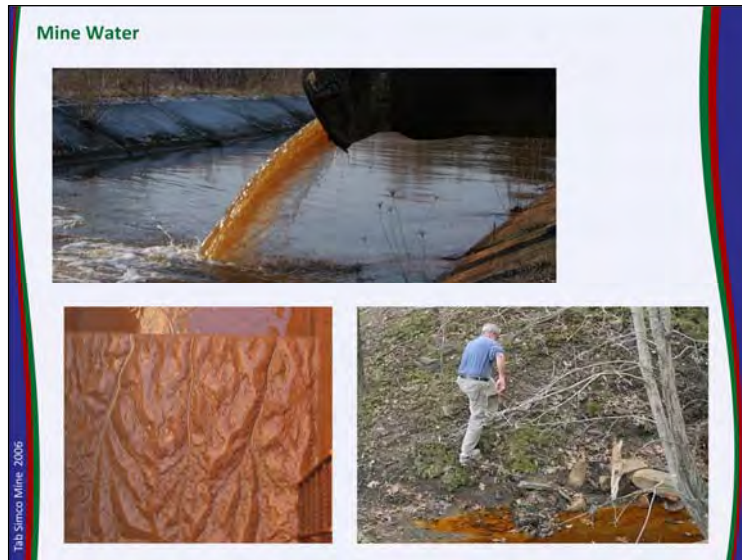
Every ascent starts in the head

Well. Ladies and Gentlemen. Relax with me for a second and let's start our ascent into what we will call



"Intelligent Mine Water management"

But let me come back to Kostenbader first.



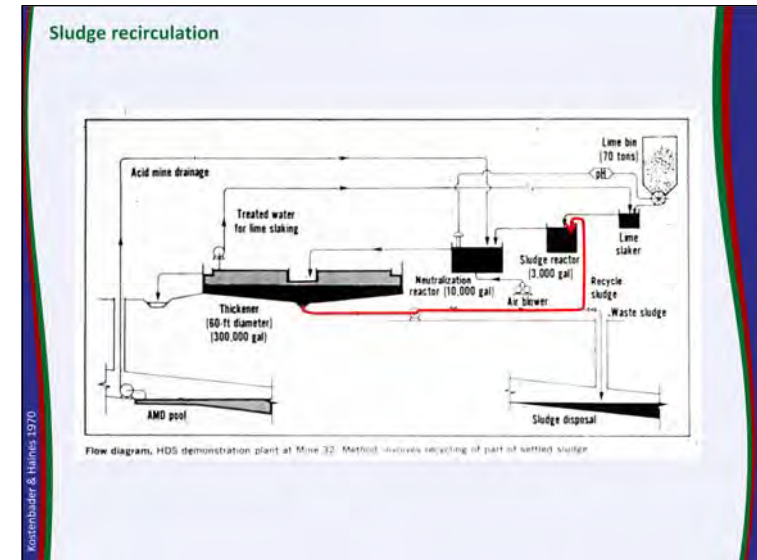
What had happened?

Kostenbader had two problems: 16,000 m³ of pH 3 mine water that needed treatment each day and not enough space to store the sludge from the lime treatment plant in a valley near Bethlehem Pennsylvania.

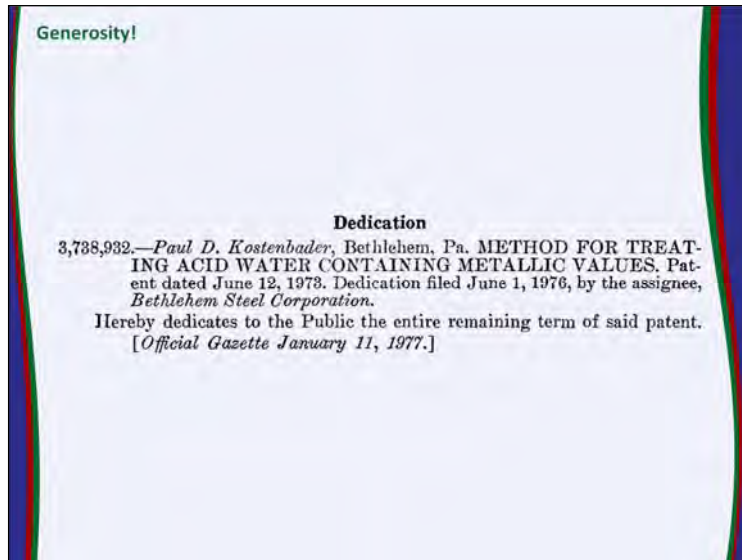
So, what to do?

He had to reduce the amount of sludge of the conventional lime treatment plant *significantly* to store the sludge in the valley. And he had to improve the sludge settling characteristics. But how? Kostenbader didn't know when he started his investigations in 1966.

His mountain, that he had to climb, was the sludge reduction and he had to start his ascent towards this goal. Kostenbader worked for about 3 years, he tried every possible option he could think of. And one day he had the idea and he concentrated on *this* idea.



His idea was to recirculate the sludge that the conventional treatment plant produced and by doing so he invented the high density sludge process. A quite simple solution, don't you think so – but a breakthrough for our business.



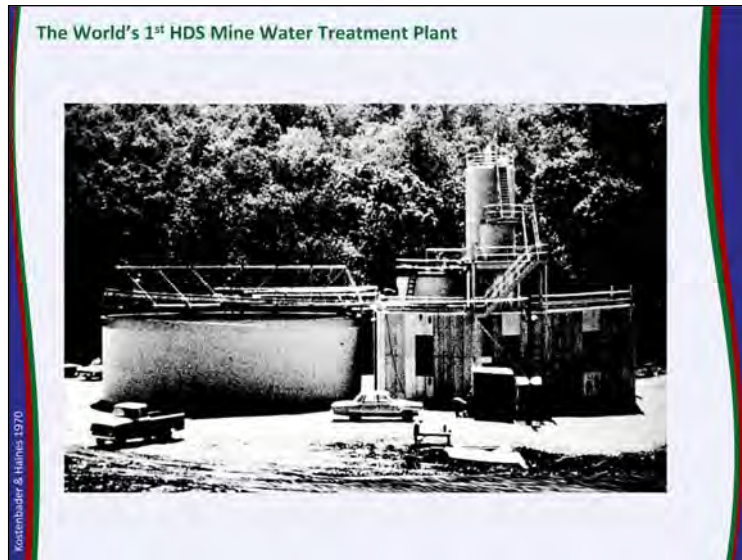
And even better: 3 years after he received his patent, Kostenbader dedicated his invention to the public and waived his income from the patent licences. By the way: here I would appeal for renaming our “Best Mine Water and the Environment Paper” award “Kostenbader Award”. That would be honouring him.

In 1973 our colleagues Karlis Svanks and Kenesaw Shumate wrote:



Bethlehem Steel Researchers, Haines and Kostenbader, have reported outstanding success in forming a dense sludge from AMD treatment with lime.

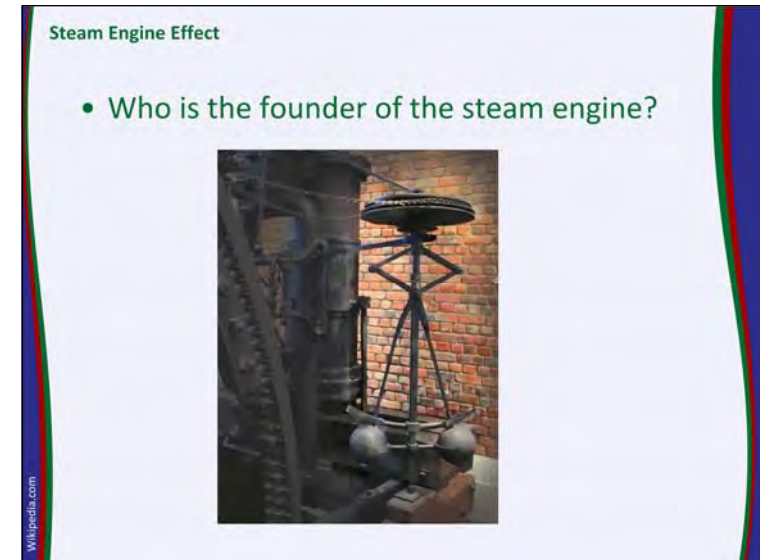
Outstanding success! That was what colleagues of that time thought – today we take the HDS process for granted.



And this invention of the HDS process was the last *real* innovation, because all other “new” technologies that we are using are not that new.

Please don't reinvent the wheel. It has already been invented!

Look into the literature and you will see that most of them have been used by others and that they are coming from other technological fields. They are small steps, of course, sometimes important steps, but mainly optimizing another process here and another there. Even passive treatment was already invented in 1966 to 1969 by German colleagues and the first semipermeable membrane was invented by the German Moritz Traube in 1864.



Well, I know what some of you are thinking now: what about the steam engine?

Who is the founder of the steam engine?

Did you say James Watt?

No, ladies and Gentlemen, it was Thomas Savery in 1698 and Thomas Newcomen in 1712. And do you know what their steam engines were used for? For mine water pumps!

But why did you think James Watt? Well, in 1788 he invented one small part, the “Centrifugal governor”, which guaranteed that steam engines didn't explode anymore! This was his invention and this was the breakthrough for the steam engine! Very similar to our HDS process, where only one small function was optimised.

What is Innovation?

Innovation is the creation of **better or more effective** products, processes, technologies, or ideas that are accepted by markets, governments, and society.

This brings me to the definition of innovation – according to Wikipedia:

Innovation is the creation of better or more effective products, processes, technologies, or ideas that are accepted by markets, governments, and society.

This was the outstanding success of Kostenbader in 1969!

Driving an old-timer: Conventional Lime Treatment



But, if you have to plan a mine water treatment plant, what type of technology are you very likely using: aeration, liming, flocculation, settling, and disposal. For decades and decades this is the method of choice if we need a quick and reliable solution. But it means driving with an old-timer.



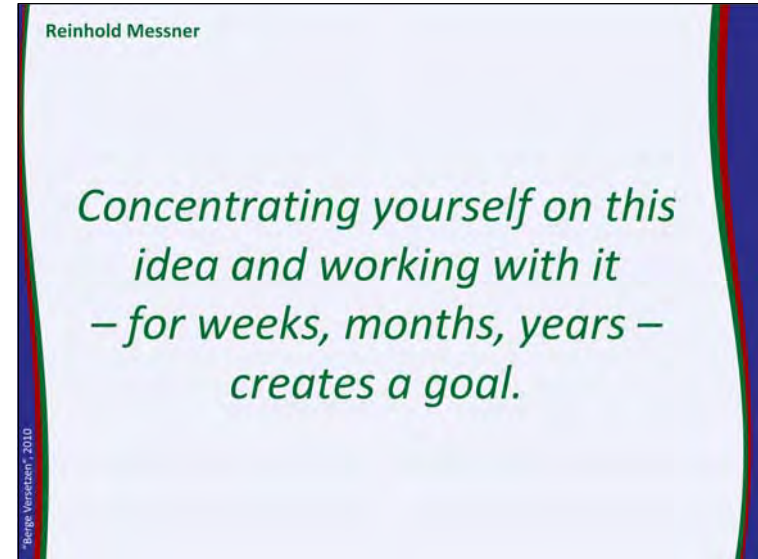
So, did you remember when you stayed the last time in bed, just to relax, just to daydream?

Long ago? Well, this is the reason why many of us don't have many new ideas.

We are conducting the next column test, the next limestone dissolution test, the next sulphate reduction reactor, the next pilot scale constructed wetland, the next test to evaluate the mean residence time in a treatment scheme, the next grout injection test in the lab, the next soil leaching test, the next DNA analysis to identify the bacteria in mine water.

We are re-inventing the wheel!

Are that really new ideas? No.



Concentrating yourself on this idea and working with it – for weeks, months, years – creates a goal.

Where is the Innovation in the Car Industry?



Peter Hensel 2004

Let's first have a look to the Mercedes Benz C 111 car. In the early 1960ies journalists criticized the car industry for not being innovative and using old fashioned technology. They asked: "Where is the new technology car"? Consequently, the bosses of Mercedes Benz asked their engineers to leave their labs and look into all the evolving technologies of that time. And they were asked to think, how this technology could be used in a new type of car.

Mercedes Benz C 111 – 1969

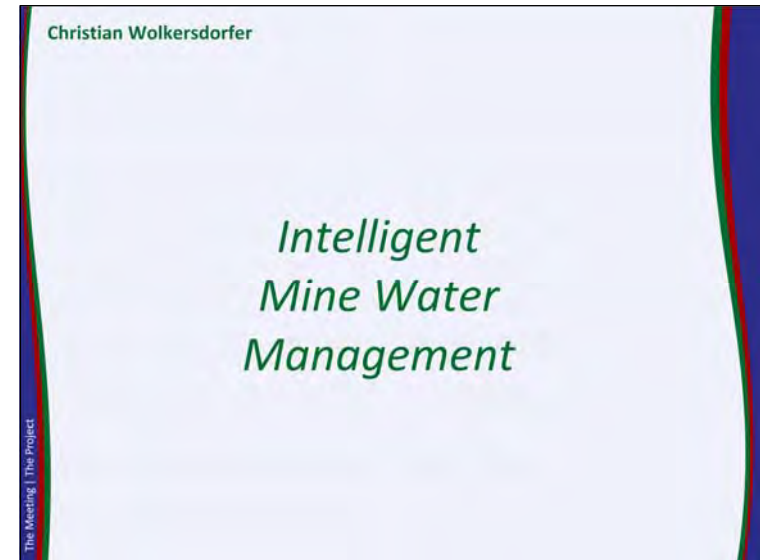


Wladyslaw at de.wikipedia

The result was the C 111 car – looks very modern, doesn't it –, the first car with a plastic car body, the first car with an air drag coefficient of 0.2 – other cars at that time had around 0.6, the first car with a turbo diesel engine and the first street car that drove more than 300 km per hour. And it was so quiet; drivers thought they drove only 150 or 160 km per hour.



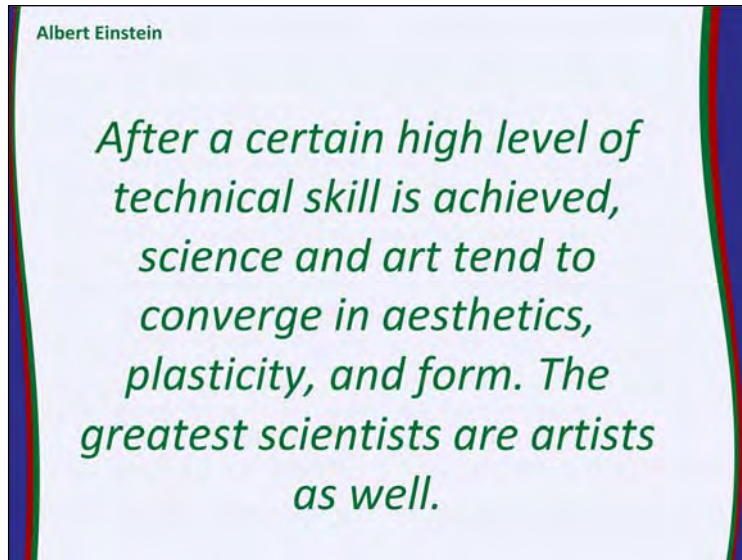
Ladies and Gentlemen. Most of us don't have time any more to think about just one idea. I took time off and quit my job at the end of April this year to think and to organise just one idea. An idea that started as a daydream roughly 2 years ago:



"Intelligent Mine Water Management"

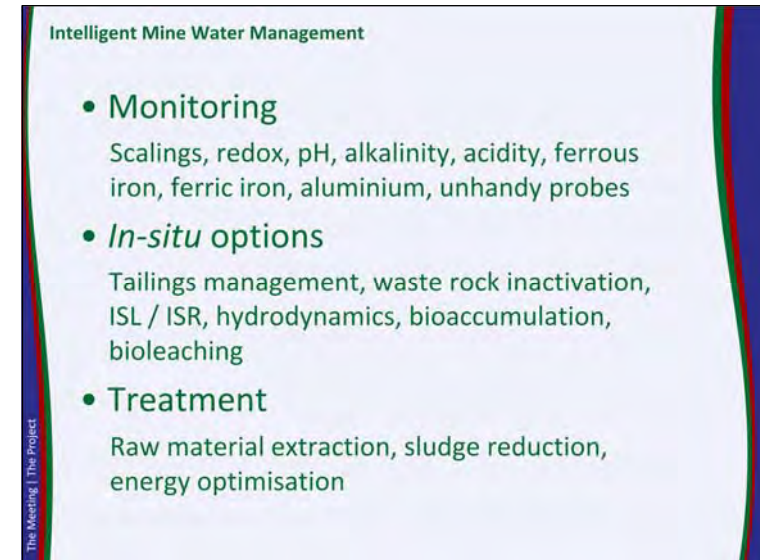
What does this mean?

About 300 years ago Science, Religion and Arts split from each other. It was not allowed any more to mix scientific findings with religious ideas or arts. This was good in one way, but bad on another – as has been shown by so many people. What did Einstein say:



After a certain high level of technical skill is achieved, science and art tend to converge in aesthetics, plasticity, and form. The greatest scientists are artists as well.

"Intelligent Mine Water Management" will be a holistic approach to monitor, manage, and treat mining influenced water. Let's have a look to some of our current problems:



Monitoring

Scalings, redox, pH, alkalinity, acidity, ferrous iron, ferric iron, aluminium, unhandy probes

In-situ options

Tailings management, waste rock inactivation, ISL / ISR, hydrodynamics, bioaccumulation, bioleaching

Treatment

Raw material extraction, sludge reduction, energy optimisation

Intelligent Mine Water Management – Arts, Religion & Metaphysics

- Let's use our inner feelings to solve some problems
- Let's be more responsible to nature and the environment
- Let's keep in mind that we are dealing with people
- Let's bring back fun into our work
- All projects should be done based on the flow principle according to Mihály Csíkszentmihályi



The diagram is a circular flow state model. The vertical axis represents 'Challenge level' from Low at the bottom to High at the top. The horizontal axis represents 'Skill level' from Low on the left to High on the right. The eight states are arranged in a circle: Anxiety (top-left, red), Arousal (top, orange), Flow (top-right, yellow), Control (right, green), Relaxation (bottom-right, light green), Boredom (bottom, blue), Apathy (bottom-left, dark blue), and Worry (left, purple).

How can we include arts and religion – or if you prefer metaphysics in our approach?

Let's use our inner feelings to solve some problems

Let's be more responsible to nature and the environment

Let's keep in mind that we are dealing with people

Let's bring back fun into our work

All projects should be done based on the flow principle according to Mihály Csíkszentmihályi [Tschikzentmichai]

These are one of the many key questions that we have to solve and consider in the future.

Back to Reinhold Messner.

Reinhold Messner

A quiet decision inside me ignites the action.

A quiet decision inside me ignites the action.

What does that mean for us?

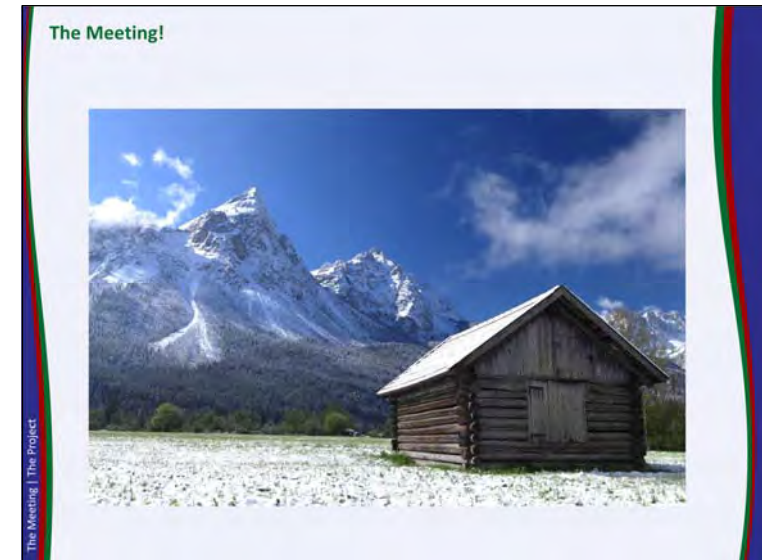


The solution, from my point of view, will be a two-step approach what I call:

The Meeting

The Project

And of course, partners and funding and you.



Let's start with "The Meeting".

This will be a one week workshop with about 20 scientists, decision makers from various areas of engineering and research. It shall take place in Austria, close to the world's most important silver mining area in Medieval times. This place is considered to be the starting point of a connection between mining and international financial affairs: the Fugger Empire which was the most prominent banking house at that time. A good place to start from my point of view.

All of those engineers and scientists will be invited and will present and discuss evolving technology for mine water management.



The estimated cost of this Meeting is 100,000 EURO and we already have a contribution of 60,000 EURO – consequently, only 40,000 are missing and if you want to be part of “Innovative Mine Water Management” feel free to make your contribution as another sponsor.

The next step is “The Project” which will evolve from the outcomes of “The Meeting”.



What needs to be done in “Intelligent Mine Water Management” – I already told you before:

Monitoring

In-Situ Options

Treatment

But what are many of our colleagues doing? They are climbing the same mountain with the same technology and consequently they reach the mountain in a similar way others did it before.



Do you know why Reinhold Messner or the C 111 car are so unique?

Yes? No?

Would you like to know it?

Well, all of them decided to walk on a new track. Let's now have a closer look to Messner. Why was he the first climber to ascend all fourteen "eight-thousanders" without oxygen and partly by himself? Why?

Because he had a dream which became an idea that lead to a goal and finally he started the action.

Ladies and Gentlemen.

Two years ago I had a dream, meanwhile it is an idea and currently the goal is forming on pieces of paper and together with you, here in this room. The next step will be to start the action – which can only be done with your help!



Please, please, my dear friends don't repeat what others already did. Perform a thorough literature research before you start your research project. Do you know how many papers about passive treatment don't cite Hedin et al. 1994 or Wildeman 1993. How reliable can such a paper be if they even didn't read the two most fundamental publications about passive mine water treatment? Think about it, please.



Take a day off, stay in bed, and think about *new* ideas. Climb a mountain, walk through the forest, or dive into the deep ocean!

But what could be those new ideas?



Let's come back to "The Project" again.

Monitoring
In-Situ Options
Treatment



Monitoring.

Do you know what that is? It is a pregnancy test. And do you know how it works?

Quite simply. Take a pregnant woman, isolate the pregnancy hormone hCG – human chorionic gonadotropin – from her urine, inject the hormone into a rabbit, the rabbit forms an antibody, isolate the antibody from the rabbit's blood, bind the antibody to a molecule of gold. That's it. Quite simply.

Now, as soon as the gold-antibody-complex binds to the hCG-antigen of a pregnant woman, which is called immunocomplex, it gets a reddish colour and you know that you are pregnant. This is called immunochromatography or immuno assay.

Who wants to try it – well, that's a joke

Those types of tests are also available for lower cadmium concentrations and some other trace metals in low concentrations.

Or do you know how the blood sugar test works?

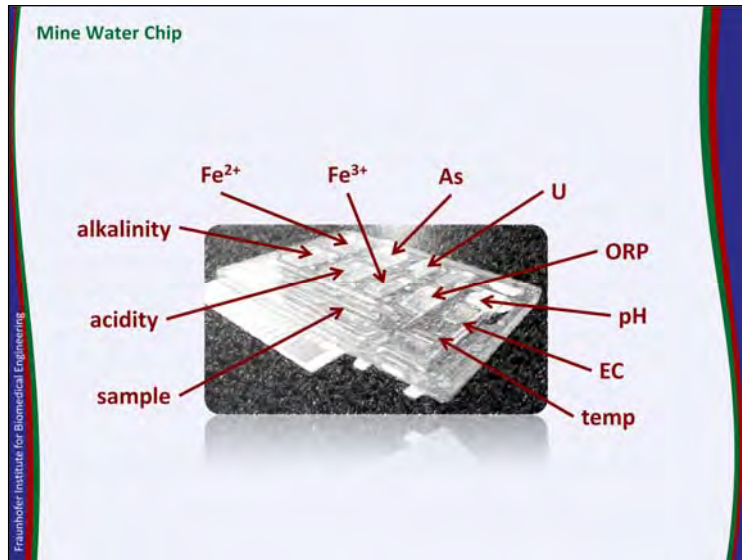
Also quite simply.

Our body has the enzyme glucose oxidase which catalyses the oxidation of glucose. This reaction is used in the blood sugar test, because the reaction releases electrons which initiate a current. This current can be measured and is a measure for the blood sugar content. This is called electro-chemical test. Quite simply.



And how do we measure alkalinity, acidity, ferrous iron, ferric iron, pH, redox-potential, aluminium, manganese today! Simply said: too complicated and time consuming.

What we need are new technologies in mine water monitoring! Not for the concentrations of those substances we find in blood or urine, but up to grams per litre.



So, why don't you develop a new pH-probe or a redox sensor or an apparatus that we can easily use in an underground mine measuring all those parameters – without all those cables or just as we would test our blood sugar or the pregnancy of a woman? Why not developing a mine water chip?

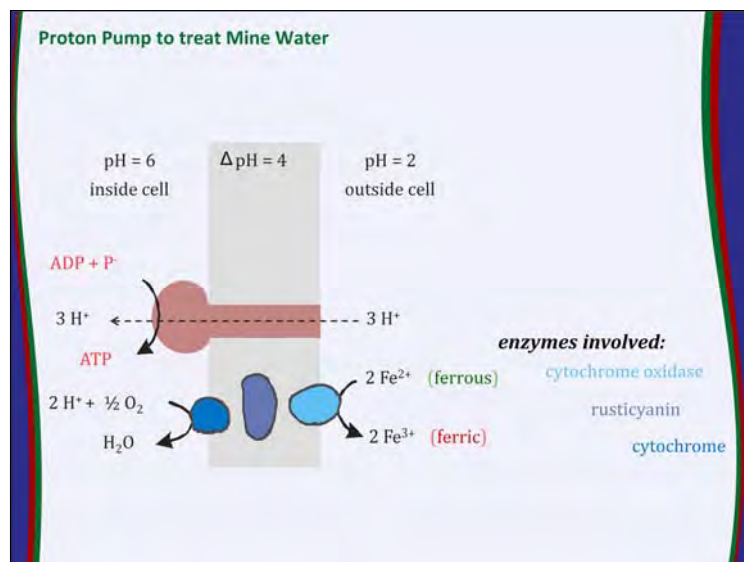


Please don't repeat a limestone dilution test that has already been published hundreds of times. Don't conduct a bench top wetland test for alkaline mine water again. It has already been done and I can tell you: it works!

I just showed you some examples for the monitoring part. Yet, what we need is a holistic approach for "The Project".

There are so many problems we have to solve in relation to in-situ options and – of course – treatment.

Just two more ideas.



Proton pump – that's what some bacteria are using to move protons into their cell through their membrane. Why don't we develop a treatment technology for acid mine drainage using a similar principle?



Salinity – there are plants that can tolerate up to 70 grams per liter of salt, such as *Salicornia bigelovii*, the dwarf saltwort. And this is done with less energy than we are using with membranes. Why don't we study those plants in more detail and try to use biotechnology more often in mine water remediation?



“The Project” will consist of about 10 experts from various fields of research. They will work together for about 8 years and develop new technologies in mine water management – some of which I described before. The total cost will be around 20 – 30 Million EURO which means 2.5 to 4 Million EURO annually, or if the largest mining companies and funding agencies would be in the boat with us, need to invest around 300,000 to 500,000 EURO annually – and the result would be “Intelligent Mine Water Management”.

In the meantime, it is you to rethink what you are currently doing. Are you responsible for a research project? Are you sure it is absolutely new?

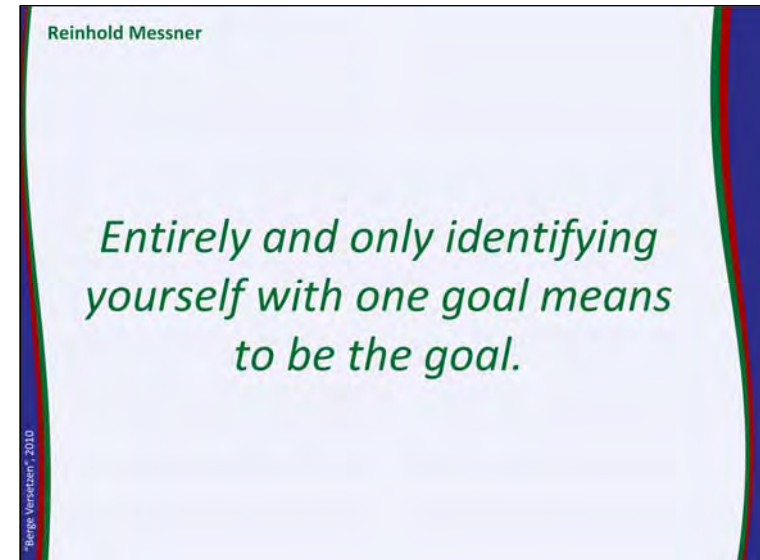


If you think you could become part of “Intelligent Mine Water Management”, please speak and discuss with me. Now or later or during one of the next days.

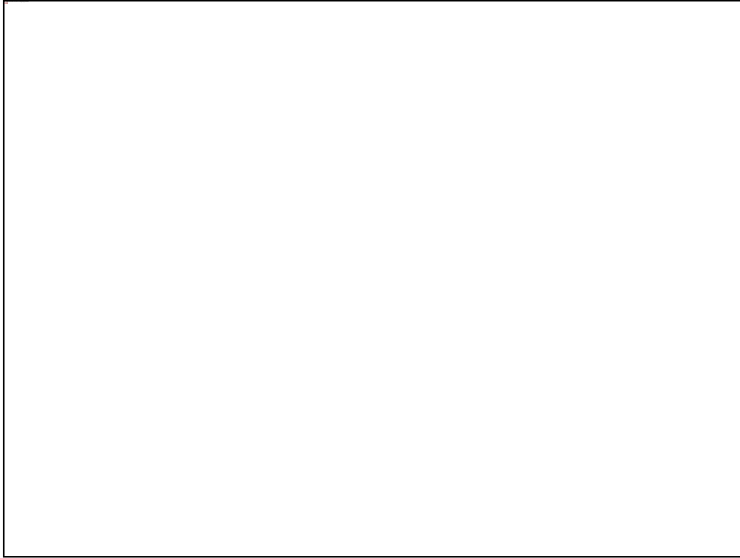
Ladies and Gentlemen.



Let's start to climb the next mountain in mine water management together. Stay in bed for one day after the end of this IMWA conference. Think about your work and please, don't forget to turn off your smartphone during that day and keep in mind:



Entirely and only identifying yourself with one goal means to be the goal.



Thank you very much, Ladies and Gentlemen,
for your attention, and I hope, you will come
with me to climb the new mountain in mine
water management. And in the background you
can see the future of mine water management –
young enthusiastic students investigating mine
water. Glückauf!