A green way to produce glass

A cooperation between the German companies Metaliq and the IGR could help solve a problem of the global glass industry by using a novel way to produce soda and hydrogen production directly in the glass factory. Hans-Ullrich Werner* and Dirk Diederich** discuss.

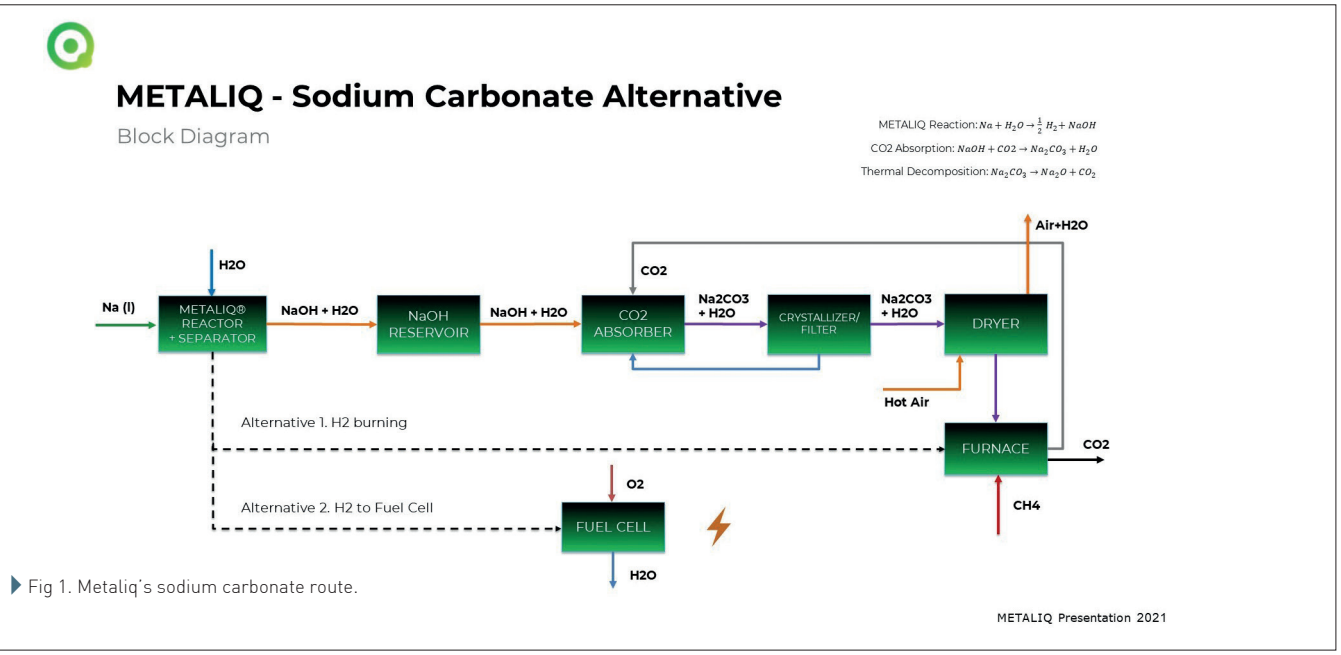

Fig 1. Metaliq's sodium carbonate route.

What is the biggest problem, mankind is facing right now?

If not the biggest still definitely one of the top 3 is the climate change!

What needs to be done in order to stop this or at least slow it down?

Reduce the CO_2 exhaust. Or even better, remove CO_2 from the atmosphere.
We have the technology to do so and it's ready to be used now.

Why do we have that technology?

Because we have hydrogen for free!
Sodium hydroxide removes CO_2 in a natural reaction from glass industry exhausts, if you want. The resulting sodium carbonate is urgently used in Glass industry.

Why do we have this for free instead of having to spend lots of money to create it?

Hydrogen is the waste product of a technology, we invented, to produce NaOH on site, to use it for burning together with natural gas or in fuel cells and you don't have to transport hydrogen anymore, if you're using our technology.

How do we produce Sodium Carbonate on site?

That's thanks to our patented and already working Metaliq Hydroxide Generator, which uses Sodium, water and later, CO_2 too.

Where does Sodium come from?

As Sodium (Na) can be found in almost endless amounts in the saltwater of the seas, sea water desalination in the future can be the solution for the urgent need for drinking water. And the waste, the salt, will be split with electrical energy from the sun into sodium and chlorine, which then would be used for PVC Tubes for transporting drinking water and which is needed in big amounts in chemical industry.

What is Metaliq?

Metaliq is an international patented technology (Escudero, 2014) for the in-situ and on-demand production of green hydrogen for power generation in conjunction with fuel cells or as a substitute for hydrocarbons with complete elimination of the carbon cycle. It is based on the chemical water splitting reaction (CWSR) with alkali/alkaline earth metals (such as Na, Li, Mg, K, etc.) and water.

For industrial applications in glass works, only sodium is used as a raw material. Metaliq (Metaliq, 2021) has applied for further patents on this, focusing on on-demand and in-situ sodium hydroxide production (***Fig 1***).

How will it be realised?

For expansions or adaptations, all plant components are modular, scalable and thus have technical redundancy. This

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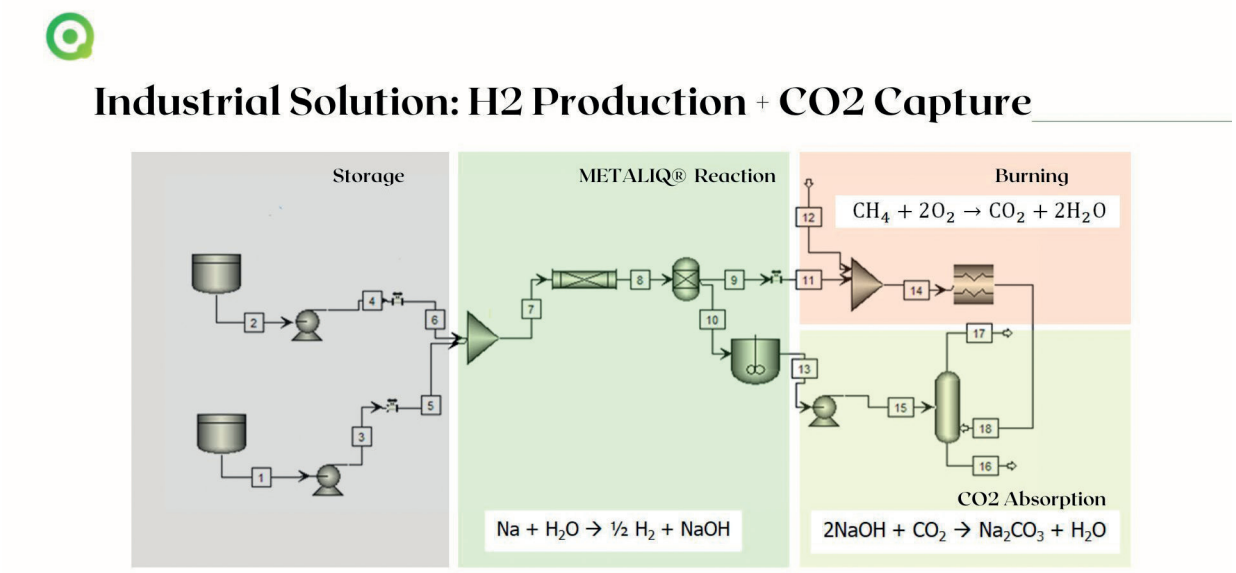

06 Fig 2. Overview of the full cycle. METALIQ Company Presentation 2021

ensures continuous production.

Why using Sodium?

Applications are well known in nuclear power plants for countless years already. Sodium is the energy carrier from which sodium hydroxide and, as a by-product, hydrogen, is produced without any further energy input.

Unlike gaseous fuels, solid sodium can now be stored indefinitely as a metal and procured at advantageous market prices.

What about Sodium Hydroxide?

Sodium hydroxide is used to capture CO_2 in order to produce sodium carbonate (soda ash) in situ. The special feature of this is that the crystal sizes of the salt can be designed for the subsequent batch.

How does it work?

Hydrogen as a by-product is produced at atmospheric pressure, mild temperatures and without any significant energy requirement and is used to heat the glass tanks by mixing it with the fuel natural gas (***Fig 2***).

Which costs will be less than before?

Because of the low cost of sodium, the cost of soda ash produced In-Situ is also low. The necessary CO_2 is waste from the chimney and free of charge. Due to the reduced consumption of natural gas and the quasi-free hydrogen
CO_2 emissions are saved, as are the procurement costs for natural gas.

How much potential does this technology have?

In the next few years, the technology will allow the direct use of sodium hydroxide in batch production, more, soda ash will then no longer be needed. This will eliminate CO_2 emissions altogether. Hybrid plants (heating with natural gas and electricity) can be realised.
Hydrogen, as a by-product, is produced at atmospheric pressure, mild temperatures and without any significant energy requirement and can be used for electricity generation in conjunction with fuel cells.

Do you have more chemical details?

The reaction in equation 1 is carried out safely and smoothly thanks to an advanced algorithm for dosage control and an efficient heat removal system to avoid a temperature rise:
$Na(s)+H_{-2}O(l) \blacktriangleright NaOH(l)+{}^{1}/_{2}H_2$

The stoichiometric mass ratio is 23 kg sodium and 18 kg water to obtain 40 kg sodium hydroxide, releasing an energy of about 140 kJ/mol Na. The actual performance of the system is excellent, as the yield of the reaction is almost 98%.
In addition to sodium hydroxide (NaOH), 1 kg of hydrogen is produced.

Sodium Hydroxide is really the best CO_2 capturer?

Yes, it is. But the market price is high if you have to buy it. But we are producing it ourselves within the glass plant.
The reactive absorption of CO_2 in NaOH has proven to be an efficient way to retain greenhouse gas emissions in flue gas streams. In fact, the CO_2 capture capacity of NaOH is higher than that of conventional amine-based solvents, such as Mono-Ethanol-Amine (MEA), which is currently almost the only commercial process used in most post-combustion plants.

Do you have some more chemical details?

This simple reaction is used to make soda ash, equation 2. The stoichiometric mass ratio is 40 kg of Na and 44 kg of carbon dioxide, which produces nearly 53 kg of soda ash and water:
CO_2 (g)+2NaOH(l)$\blacktriangleright Na_2$ CO_3 (aq)+H_2 O(l)
The strong binding energy associated with this reaction offers the potential for high CO_2 loads in a wide range of operating conditions and system designs.

What is in summary to say?

Each ton saved Carbon Dioxide produce 1.2 t soda ash and 'Green Glass'. ■

More information

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