

C5. Final evaluation report

LIFE16ENV/NL/000217 Waste2Kaamera



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Summary

LIFE Waste2Kaamera has as its main objective to develop a new and innovative value chain for granular sludge produced in the wastewater treatment. By recovering Kaamera from the sludge and developing a value chain of bio-based products, the project aims to valorise industrial side streams and wastewater that are currently not exploited and even disposed of.

Concretely, the project extracts Kaamera from granular sludge at two Kaamera Extraction Installations (KEI) at the locations Zutphen and Epe. The extracted Kaamera is valorised to marketable products for different sectors. The technology is implemented on a semi-industrial scale producing Kaamera when there is a market demand. Only basic valorisation with a suitable conservative takes place at our premises. Sometimes we use a dedicated valorisation step (e.g. drying of Kaamera) externally.

A viable business case for various value chains is possible but more market development has to be taken place. With the urgency and ambition in the field of sustainability and circularity in mind an exploration was carried out in 2022 into the possibilities of scaling up Kaamera. Both in terms of product development and more sales and therefore production, and in terms of the number of water boards participating in the collaboration, for scale optimization, and potential market parties, for more carrying capacity. This has led to a proposal to form a cooperative of 5 water boards and the establishment of a start-up BV of the 5 water boards with RoyalHaskoningDHV. This proposal will be submitted to the boards of the water boards for decision-making in the autumn of 2023. This development will reduce the environmental impacts of waste water treatment in terms of sludge production, transportation and energy consumption.



The LIFE waste2Kaamera project was realised with the contribution of the LIFE Program of the European Union.

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Introduction

Kaumera

Kaumera Nereda® Gum is a new bio-based raw material that is extracted from the sludge granules that form during the Nereda® purification process. The Netherlands has the world's first two Kaumera Extraction Installations (KEI): the first production site is in Zutphen (2019) for processing an industrial side stream, a second plant was opened in Epe in 2020 for processing municipal sewage based sludge.

By removing Kaumera from the purified sludge, 20- 35% less sludge needs to be removed and processed. This has a positive effect on energy consumption and CO2 emissions.

A versatile name

Kaumera. It is a versatile name for a versatile product. Kaumera means 'chameleon' in Maori, the language of the original inhabitants of New Zealand. The chameleon is known for its colourful transformation and adaptability. This makes the chameleon a beautifully flexible, effective and versatile animal.

Infinite application possibilities

Kaumera can retain water but also repel it. This makes various applications possible, for example in agriculture, horticulture and construction market segments. These include reducing the leaching of fertilisers in agriculture. As a result, crops absorb fertilisers better. They are more resilient and grow better.

By combining Kaumera Nereda® Gum with another raw material, the character of the substance changes. Kaumera is an amplifier and connector of properties. For example as part of lightweight bio composites. This ensures that the application possibilities are practically endless.

Extraction processes up and running

From October 2019 the Kaumera extraction installation in Zutphen has been started up. We have done this in steps. As soon as a process step was under control, we proceeded to the next step. Kaumera is new and we are the first in the world to produce it. That's why you can't quite predict what you will encounter. Sometimes things went smoothly, sometimes there were unexpected situations that had to be solved. Our colleagues, together with experts from the Kaumera partners, have worked hard to arrange the process properly. The next step 24-hour production, was reached at the end of 2021.

Since autumn 2020 also the second Kaumera extraction installation at the location Epe has been started up. First months some adjustments were needed for safety and performance. After that stable production process with KEI Epe is possible. There were some deliveries for the market. For the Epe location the goal was reached!

However, the Kaumera production in practice is approx. 67% of the design capacity or even lower because of minimal automation of the facility.

Conclusion: The current KEI work fine as a demo facility, but the scale and set up of the Epe Kaamera extraction installation is not optimal for continuous production. It is too labour-intensive and too expensive.

Award winning

The cooperating partners in the NKOP (National Kaamera Development Program) have won several important prizes and nominations:

We have won the Water Innovation Award 2019 and the prestigious Aquatech Innovation Award 2019. Furthermore, Kaamera was one of the finalists for the Circular Awards. In September 2020, one of the Kaamera Partners won Water Technology Company of the Year in the Global Water Awards 2020.

Long term cooperation

Koppert Biological Systems, Chaincraft and RoyalhaskoningDHV, at the end of 2021, have signed a multi-year collaboration contract for sale and knowledge sharing in the application of Kaamera as a biostimulant.

This is an important step for the development of Kaamera, as it demonstrates that the market also has confidence in its application.

Evaluation of Project

What have we achieved?

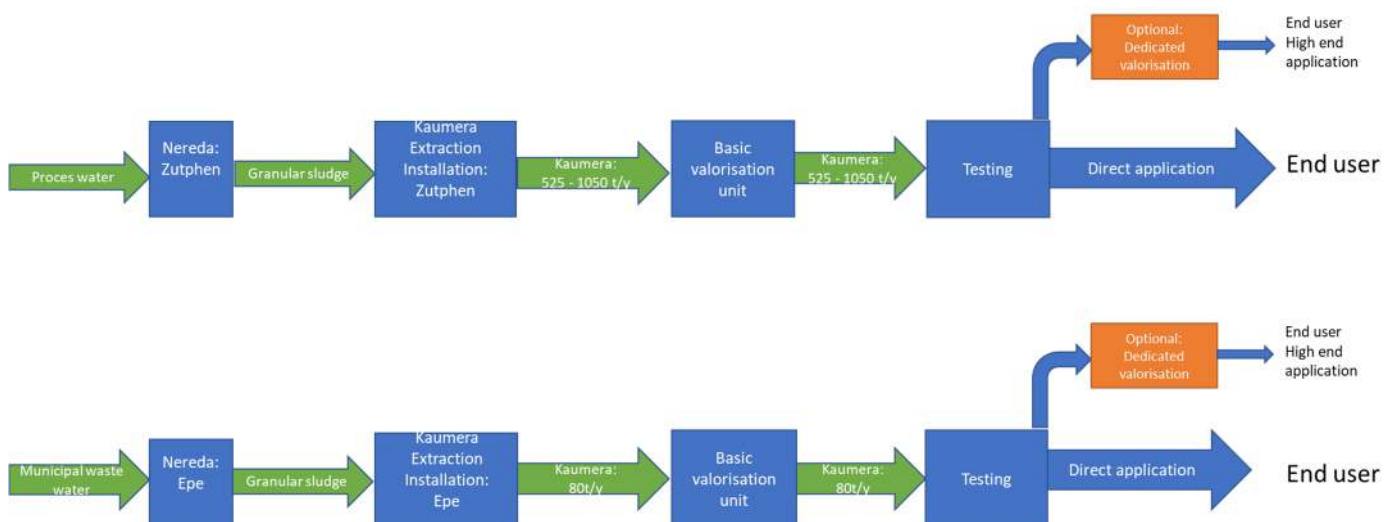
The Waste2Kaamera project ensued in positive results. The worldwide first of its kind Kaamera Extraction Installation's (KEI) are in place and in operation in Zutphen and Epe, with basic valorisation. Monitoring activities have been undertaken and led to process optimisation. Development of markets and value chains are on its way, and have succeeded into a sales agreement with a buyer. Also other routes to valorise the extracted Kaamera have been explored, but more effort and more cooperation is needed.

The valorisation and market introduction of Kaamera proved to be more difficult than anticipated. Convincing the market of the product and its quality is of primary importance, and any necessary valorisation step, making it suitable for customer use, is the next step. Also regulation poses several difficulties in market introduction, especially in internationalisation of markets

Kaamera is a unique raw material that the consortium partners want to introduce in a number of existing and new markets. This primarily means that potential customers in these markets need to be convinced of the product, its quality and stability. The first step in valorisation is therefore to make sure that the Kaamera produced in the KEI is well conserved, for which a basic valorisation step of adding and mixing in conservatives for all Kaamera produced is required. The second step is to convince interested buyers of the potential of the raw material in their sales market.

As a result of progressive insight, we were convinced that the valorisation activities should have a broad approach. Beside basic valorisation as a process step, it should also include strong emphasis on business development and large-scale testing for various applications. We were convinced that we need to install a dedicated valorisation unit where the Kaamera is being dried. Then the Kaamera is better conserved and more easy transportable, so it can be used for more applications. For specific markets (mostly high-end applications) potentially a tailored valorisation unit as the resulting final element may be needed.

Summarised in a figure:



We intended to install a dedicated valorisation unit at the end of 2022 where the Kaumera can be dried. Unfortunately our efforts to buy and install a suitable dryer were not successful. We have elaborated on that but unfortunately we have encountered several setbacks. So we were not able to buy a suitable dryer (within LIFE timeframe). But we have found an alternative to investing in a dryer, namely to contract a company to do the drying for us externally. By using this alternative of external drying options we were able to meet the project's objectives.

Project results

- Baseline monitoring has been concluded.
- For market introduction, the brand name Kaumera was developed.
- The highly innovative, first of its kind Kaumera (formerly indicated as Neoalginat) extraction installations (KEI) on the locations Zutphen and Epe have been realised.
- The installation in Zutphen is operational since the end of 2019 and the installation in Epe is in operation starting from August 2020. By realisation of an industrial Nereda and Extraction unit at WWTP Zutphen (capacity 525 tons dry solid Kaumera/year, this can be doubled over time) and a municipal Nereda/extraction unit at WWTP Epe (80 tons dry solid Kaumera/year) we can cover the most relevant waste water streams that have the potential to be a feedstock for Kaumera production.
- During the official opening of the Extraction plant in Zutphen a very successful launching event was held where Kaumera was introduced as a new multi-purpose material. This launching event has incited much interest of parties of different sectors.
- Autumn 2020 we created a press article and a short movie to announce the opening of the Epe plant.
- For the Zutphen and Epe plant monitoring is completed.
- First batches of Kaumera have been produced. The first batch of Kaumera (22,4 m3), produced by WRIJ was delivered through Chaincraft on 12 March 2020 to innovative agricultural company Koppert Biological Systems to enable large field trials for the Kaumera application as biostimulant in agriculture.
- The second batch of Kaumera was delivered on 5th (5m3) and 25th of February (5m3) 2021 by WVV, also to innovative agricultural company Koppert Biological Systems for field trials.
- Koppert Biological Systems, Chaincraft and RoyalhaskoningDHV, at the end of 2021, have signed a multi-year contract for collaboration in the application of Kaumera as a biostimulant.
- The first challenges to policy impact have been Kaumera's regulatory aspects. Both REACH and End of Waste (EoW) are required. As for End of Waste, raw materials from sewage are considered waste until the opposite is proven. A material ceases to be waste if the following conditions are met:
 - the material is earmarked for a specific purpose
 - there is a market for the material
 - the material meets the technical regulations for the specific purpose and standards for products
 - there are no unfavourable effects on the environment or health.
- Both location Zutphen and Epe created a file that proves the criteria are met. Clearly, the market can only be developed if these criteria are met. The process of obtaining EoW status in the Netherlands, however, remains somewhat cumbersome. The market is hesitant to sign an agreement without an agreement on EoW status from the authorities. Meanwhile, the

competent authority indicates that they need a signed agreement from the market before they give their agreement (if they do so at all, because they are not obliged to) on the EoW dossier. This places responsibility with the producer of the raw material and the buyer to somehow establish that a substance is a raw material. In addition, each application and location requires a separate EoW dossier, and the requirements placed on the dossiers are unclear. The result is a very labour-intensive and lengthy procedure.

For the application as bio-stimulant, both Epe and Zutphen have built up an EoW dossier. Zutphen's dossier has been approved by regional environment agency, and Epe's dossier will be submitted most probably in the last months of 2023 (please note this is not obligatory, but an additional step taken to strengthen our position). For other applications, new EoW dossiers have to be established. Hence, this will be an ongoing process.

- Upon receiving EoW status Kaumera ceases to be waste and becomes a substance. The European REACH regulation will then apply. REACH requires the registration of substances when manufactured or imported (> 1 tonne per year). Kaumera meets the definition of a polymer under REACH. Since the extraction process itself does not impact the formation process Kaumera qualifies as a natural polymer, no registration of monomers is required.
- We are currently exploring market opportunities and co-operation with potential parties in new to build value chains. Based on this, large interest from different companies from various industries for co-operation has been identified.
- We have recognized the need for more substantial market development and have set up a Kaumera Market Hub in order to strengthen development of new value chains. The actual value chains to be developed will have an impact on the needs and demands of valorisation. It has already become clear that testing of Kaumera in specific applications is a very important activity to pursue, especially to overcome identified barriers, such as inconsistency in quality, performance and appearance. Although the Market Hub has identified some prospective routes for valorisation, it became clear that full time, dedicated and specialised staffing is essential and could not be provided by the partners.
- Basic valorisation (stabilisation and conservation of product) is always needed and in many 'lower end' applications adequate. So, for all Kaumera produced a basic valorisation process takes place.
- For the basic valorisation a lot of research was done. Preservation moved away from biocide and we now use similar preservatives which are used in the food industry.
- We intended to install a dedicated valorisation unit at the end of 2022 where the Kaumera can be dried. Then the Kaumera is better conserved and more easy transportable, so it can be used for more applications. Unfortunately our efforts to buy and install a suitable dryer were not successful. We have elaborated on that but unfortunately we have encountered several setbacks.
 - We have executed several drying tests. These show still uncertainties in best way to dry.
 - Due to the Ukrainian war there is a scarcity of materials. Delivery times for a new dryer are more than a year. We did not manage to buy a suitable second hand dryer.
 - Energy prices have risen tremendously – the economic feasibility of drying of Kaumera in the current economic situation is not there and is very uncertain for the future.

So we were not able to buy a suitable dryer (within LIFE timeframe). Furthermore, buying a dryer under present market circumstances is risky/less desirable from a business perspective.

- We have found an alternative to investing in a dryer, namely to contract a company to do the drying for us externally. By using this alternative of external drying options we were able to meet the project's objectives.

After all, the project demonstrates the innovative valorisation of waste water solids into valuable Kaumera, including dedicated valorisation. With this, water boards and industry have entered into a new phase: from a focus on waste water treatment to a focus on the production of bio-based products.

Evaluation of Project Objectives

The main objective was a successful demonstration of an innovative and appealing bio-based value chain, that produces high value Kaumera from granular sludge produced in wastewater treatment. Representative settings on pre-industrial scale as well as the use of feedstock from 2 different sources (municipal and industrial wastewater (food process water)) would assure that results are widely applicable and reproducible. The installations at Zutphen and Epe have been fed with industrial and municipal wastewater respectively, and produced and refined Kaumera.

The project objectives compared to realization show that:

1. Implementation of a full-scale demonstration plant of 1.000 tons/year ds Kaumera.

Situation June 2023

We realised an industrial Nereda and Kaumera Extraction unit at WWTP Zutphen (capacity 525 tons dry solid Kaumera/year, this can be doubled over time) and a municipal Nereda/extraction unit at WWTP Epe (80 tons dry solid Kaumera/year). With these facilities we cover the most relevant waste water streams that have the potential to be a feedstock for Kaumera production.

2. Full-scale demonstration and monitoring of the recovery of Kaumera from granular sludge and valorisation for a period of about 36 months.

Situation June 2023

Q4 2019 we started monitoring for Nereda-Kaumera extraction and basic valorisation at Zutphen facility. Q4 2020 we started monitoring for Nereda-Kaumera extraction and basic valorisation at Epe facility. At the end of 2022/beginning 2023 we did some monitoring of the dedicated valorisation (external drying unit). This overall monitoring period of about 3 years was sufficient to acquire realistic data on the robustness of the entire Kaumera value chain.

3. Dissemination of results.

Situation June 2023

Q4 2019 there was a successful Kaumera Launch. The interest was quite overwhelming. It is safe to say that we reached our goals of launching Kaumera with impact and made a wonderful start to build brand awareness.

- *6 national TV networks and newsplatforms, including prime time news at NPO1, the primary news network in the Netherlands*

- Over 25 regional networks and business publications
- Over 900.000 primary views on social media platforms in the first week of October with over 115.000 likes and reposts
- In total 2.900.000 views on social media in Q4 2019

It started a flow of requests for more information and for tours of the installation. These visits are an important part of the way we spread the story of Kaumera. Despite Covid restrictions, we have been fortunate to welcome over 2000 visitors at Zutphen and Epe, with numerous nationalities. In addition, we also received many government officials, often at their own request. Amongst them were the Dutch minister of Infrastructure and Watermanagement and the Dutch King's commissioners of the provinces of Overijssel en Gelderland. In our view, these visits are instrumental in building brand awareness and support for Kaumera.

From 2018 until now we had several communication moments (see communicatons calender). At the end of 2023 we expect to publish a STOWA report about the about 3 year experience with Kaumera extraction, the results and issues encountered, including the monitoring data, experiences from operators. A draft version is just ready (annexed as B2 report) and will soon be handled in the STOWA Supervisory Committee.

All-in all, we have been very active with our communications task. Next to a wide social media reach, we have achieved a good quality online presence as well as good press. A Google search on Kaumera today results in almost 7.500 unique pages and news items. The market and our environment respond positively and still contact us on a regular basis for more information or cooperation. We are very proud of these results and we remain committed to work hard in order to see Kaumera succeed to its full potential.

4. Direct and successful contribution to the integration of the results in European policies with regard to:
 - a) Realisation/concretisation of the transition towards a biobased economy by recovery and successful valorisation of valuable resources from sewage sludge.

Situation June 2023

By realising/operating the facilities and the End of Waste and Reach trajects the project is a good example of the transition towards a biobased economy

- b) Reduction:

At project start we foresaw a reduction:

- *of granular sewage by 35% => 5.200 tons/year;*
- *of the energy footprint by 18,4 TJ/year;*
- *of greenhouse gas emissions =>1.140 tons CO2-equivalents/year.*

Situation June 2023

We have experienced the reduction of granular sludge in practice is not 35% but about 30%. Because the lack of customers at the moment we produce only one tenth of the Kaumera. So the reduction will also be one tenth. We are convinced that in some years, as the Kaumera Cooperation of 6 waterboards and the Start Up BV (6 waterboards with RoyalhaskoningDHV) activities are succesfull, there will be a production shift, probably with the mentioned reductions.

At the moment we roughly calculate a reduction:

- *of granular sewage by 30% => 445 tons/year;*
- *of the energy footprint by 1,84 TJ/year;*
- *of greenhouse gas emissions =>114 tons CO2-equivalents/year.*

- c) Demonstrated high replication potential by an attractive cost-benefit ratio with short payback period of 4-5 years.

Situation June 2023

At the moment there is no positive business case. We are convinced that in some years, as the Kaumera Cooperation of 5 waterboards and the Start Up BV (5 waterboards with RoyalhaskoningDHV) activities are succesfull, there will be a positive business case, probably with the mentioned payback period. But we have to have “a long breath”.

- d) Contribution to European Innovation Partnership (EIP) on water.

The European Innovation Partnership on Water - EIP Water in short – was active between 2012 and 2020 as an initiative within the EU 2020 Innovation Union and facilitated the development of innovative solutions to address major European and global water challenges. Project results of Waste2Kaumera only became apparent after 2020, which was in fact too late to incorporate these in the EIP Water. Currently there is no successor initiative known to the project partners. However, we will look into the best way to make results available in the best way.

- e) A Life Cycle Analyses (LCA) of the Kaumera production cycle.

Situation June 2023

In the second half of 2021 CE Delft started with the LCA. This was completed mid 2023. The results are reported below under f.

- f) An environmental impact report of the total value chain.

The environmental costs of 1 kg Kaumera are highly scenario-dependent. The result is sensitive for the energy source, the choice between NaOH and KOH, and the amount of lye and HCl that is used.

The environmental impact depends strongly on which products are avoided or replaced by Kaumera.

In its function as a binder in manure, the application of Kaumera has a clear climate impact benefit, with 0.22 kg CO₂-eq./kg DS Kaumera in the basic analysis and 9,89 kg CO₂ eq./amount of lignosulphate powder replacing 1 kg DS Kaumera. Also if Kaumera alginate from seaweed replaces Kaumera has a clear environmental benefit. The climate impact of alginate from seaweed is 2.7 kg CO₂-eq./kg.

Whether the use of Kaumera as a replacement for other products has an environmental benefit depends on how much Kaumera is actually needed to replace 1 kg of product, etcetera, and what the climate impact of this product is.

The analysis is based on a compilation of data from the installations at WWTP's Epe and Zutphen that approximates future large-scale Kaumera recovery at communal WWTPs as closely as possible.

These transferable project settings allow for easy replication, for which great interest has already been expressed (Limburg Water Authority, Stichtse Rijnlanden Water Authority, Irish Water, Brasil,

Kazachstan). This will allow water boards and industry to enter a new phase: from a focus on waste water treatment to a focus on the production of bio-based products. The project demonstrates:

- Successful foundation of a value chain for waste water-based Kaumera (from source to end-user!).
- About 30% less sludge production, transportation, and treatment, resulting in a significant improvement of environmental/economical footprint of WWTP.
- In the near future we expect to reach a significant lower energy use due to reduced sludge production and replacement of fossil based commodities.

Evaluation of partnership

The recovery of Kaumera from wastewater takes place within the National Kaumera Development Programme NKOP. In this programme, the Vallei and Veluwe Water Authority, Rhine and IJssel Water Authority, ChainCraft and, the Dutch Foundation for Applied Research in Water Management (STOWA) as LIFE partners worked closely together with the Royal HaskoningDHV engineering consultancy and Delft University of Technology.

Overall, this partnership has worked out very well. All parties contributed part of the knowledge and expertise needed to recover, process and market the new raw material. From laboratory research to full scale recovery. In this way, the Water Authority, the scientific community and the business community worked together on a sustainable, circular economy.

However, commercial LIFE partner Chaincraft indicated at the end of the project that the limited success in terms of sales so far and the anticipated time to market for further development has brought them to reconsider their position. In effect, they stop their contribution for further development of Kaumera and its market at the LIFE project end.

Conclusions and outlook

Conclusions

Waste2Kaamera had successfully demonstrated a new and innovative value chain for granular sludge produced in the wastewater treatment. By recovering Kaamera from the sludge and valorising a value chain of bio-based products, the project succeeded to valorise industrial side streams and wastewater that are currently not exploited and even disposed of.

Concretely, the project recovers Kaamera from granular sludge at two Kaamera Extraction Installations (KEI) at the locations Zutphen and Epe. On our premises only basic valorisation with a suitable conservative takes place.

The extracted Kaamera is valorised to marketable products for different sectors. The technology is implemented on a semi-industrial scale producing Kaamera when there is a market demand. Despite many efforts, only one successful delivery contract has been closed. A viable business case for various value chains seems possible but more dedicated and specialized market development has to take place.

Outlook

With the urgency and ambition in the field of sustainability and circularity in mind, an exploration was carried out in 2022 into the possibilities of scaling up Kaamera after the LIFE project. This is deemed essential: both in terms of product development and more sales and therefore production, and in terms of the number of water boards participating in the collaboration, for scale optimization, support and to attract more potential market parties.

This has led to a pre-proposal to form a cooperative of 6 water boards in which the production of Kaamera will be realised and the establishment of a start-up BV of the 6 water boards with RoyalHaskoning DHV for the business development. This pre-proposal has to be worked out in more detail for the practicalities of such a step and to provide the respective boards of the organisations involved the relevant information for decision making.

To keep the momentum, the preparation process will be intensified just after the 2023 Summer holiday period, in order to be able to submit a final proposal for decision-making in the autumn of 2023. Final decisions might be expected in the last months of 2023 or early 2024.

Once successful, this development will reduce the environmental impacts of waste water treatment in terms of sludge production, transportation and energy consumption.

Q&A about Kaumera

1. How is Kaumera doing?

The installations are in operation

The Nereda treatment plant in Zutphen has been in operation since January 2019. As of October 2019, the Kaumera extraction plant in Zutphen started up. We have done this in steps. As soon as a process step was set up, we moved on to the next step. Kaumera is new and we are the first in the world to make it. That's why you can't quite predict what you will encounter. Sometimes things went smoothly, sometimes there were unexpected situations that had to be solved. In that sense it was pioneering work. Experts from different disciplines and from all partners worked intensively together to make the process run smoothly. After six months the first Kaumera was delivered. We are now continuously working on optimizing the process. Since corona, this has sometimes been somewhat delayed due to restrictions in the transport of materials and opportunities to get experts on site. The next step a 24-hour production was realised.

The second installation in Epe

In Epe, Waterschap Vallei en Veluwe has built a second Kaumera extraction plant that is connected to an existing Nereda treatment plant. Epe was started in 2020 and the first delivery took place in November 2020. In Epe, Kaumera is extracted from communal waste water, in Zutphen we use residual water from the dairy industry. Both water authorities and other partners are working together.

2. What are some of the highlights of the past years?

Awards

The cooperating partners in the NKOP (National Kaumera Development Program) have won several prestigious awards and nominations:

- Aquatech Innovation Award Winner 2019
- Water innovation Award 2019
- finalist Circular Awards 2019
- Winner (RHDHV) Water Technology Company of the Year in the Global Water Awards 2020

First delivery

See item 4, sales and finance

Publicity

We have been approached by dozens of media for general or specialist articles. After the launch we saw a large reach in the media, this has actually continued the year after.

Visits Raw Materials Plant

The first year after the opening we received many guests in Zutphen like participants of Aquatech, other water authorities, professionals from the water world, delegations interested in purchasing a Kaumera installation, government representatives, education, groups of residents.

Unfortunately due to Covid 19 this was not possible for about 2 years. We have made a short video tour and continued to receive guests from spring 2022.

<https://www.youtube.com/watch?v=btpj73u8qTI>

3. What applications are there?

Agriculture

There are promising applications for Kaumera in agriculture. It can be applied as a bio-stimulant and as a slow release fertilizer. Chaincraft is working with various partners on testing and field research. In March 2020 a first delivery was delivered for application on a practical scale.

Building materials

(concrete) coating, building blocks, plate material and stucco material

We are in cooperation with Eco-Makelaar and Saxion about a possible internship assignment in the field of biobased plastering based on Kaumera and biomass.

Composite material

COMPRO

Amsterdam institute for Advanced Metropolitan Studies: <https://www.ams-institute.org/news/can-we-build-bridges-paper-we-flush-down-toilet/>

The COMPRO project builds on the results and insights of WASCOM - in which two large organic waste streams are upcycled to produce high-quality building materials for the city. These waste streams are cellulose fibers from recovered toilet paper and Kaumera. Together they can be used to produce a fully biobased and circular composite material. A material that can be valuable to the construction industry: it has a low weight and similar strength and stiffness to Kevlar.

Omlab

With Omlab we are realizing a project on biobased printing applications with lime, Kaumera and Cellulose. See also: <https://www.omlab.nl/onderzoek-printbaarbiobased/>. We have also involved the workgroup cellulose of the EFGF.

Flocculant

An exploration of the application of Kaumera as a flocculant, coating or thickener is being set up. Flocculation is used in water purification to remove substances from water. This process is applied in the purification of ground and surface water into drinking water as well as in the purification of sewage water. After floating particles in water have been destabilized by coagulation, they can flock together by slow movement in the water. Flocculants accelerate flocculation to larger flakes. The formed flakes can be removed from the water by letting them settle or flocculate or by filtering them out in a sand filter.

Polyelectrolytes are used as flocculants, chemicals consisting of long molecules (polymers). In addition to synthetic flocculants such as polyacrylamide, natural flocculants can also be used.

Fire resistant material and extinguishing agents

Research into various applications because of the excellent fire resistant properties of Kaumera.

4. Sales

Has Kaumera already been sold?

In March 2020, the first delivery of 20 tons was sent to biotechnology company Chaincraft, one of the cooperation partners. The Kaumera has been used by Koppert Biological Systems for application as a bio-stimulant. The first results are favorable and the follow-up came: Koppert Biological Systems, Chaincraft and RoyalhaskoningDHV, at the end of 2021, have signed a multi-year contract for collaboration in the application of Kaumera as a biostimulant.

What are the revenues?

We do disclose information on selling prices, it is confidential information.

Other info about sales

For the further market development of Kaumera, a Market Hub is set up, an organization that fully focusses on developing applications and entering into partnerships for this purpose. A newly hired business developer is the driving force behind this. All partners provide experts who are deployed for this market hub in their own field of expertise.

5. Expectations near future

That is still hard to say. We have a multi-year contract for the sales as a bio-stimulant and high expectations for the sales as a slow release fertilizer. This application can be tested in a reasonably short period of time. Other applications may take longer. We cannot determine that yet. But we are convinced that there are considerable sales opportunities and that they may be exploited as early as next year. With the new market hub, we can devote even more effort to well-coordinated research and knowledge sharing.

www.kaumera.com

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