



kaamera

Raw materials from water



Waste2Kaamera, first demonstration in the world for the extraction of the new raw material Kaamera from waste water streams (LIFE16/ENV/NL/000217)

The Kaamera plants in Zutphen and Epe are the first field-scale plants in the world. In addition to treated clean water, the plants deliver an entirely new raw material: Kaamera. By extracting Kaamera from the treated sludge, approximately 30% less sludge needs to be disposed of and destroyed. This has a beneficial effect on energy consumption, CO₂ emissions and water treatment costs. Kaamera is a biopolymer that has many promising applications due to its special properties. It can retain and repel water, it is fire retardant and an excellent binder for composite materials, among others. Since its introduction, products have been in development in agriculture, forestry and horticulture, the construction industry and the world of new materials and composites.

In 2019 and 2020, the Kaamera plants went into operation. Since then, there has been ongoing research on the plants. Much effort has been put into finding suitable outlets for Kaamera and taking the various steps to obtain “end-of-waste status,” among other things. The project was carried out by water authority Rijn and IJssel, water authority Vallei and Veluwe, biotechnology company ChainCraft and the knowledge institute STOWA. Delft University of Technology and Royal HaskoningDHV also play an important role in this cooperation. The European Community supported the project through a LIFE grant.

By extracting Kaamera from residual and wastewater, we reduce energy consumption and CO₂ emissions, but we also add value to the water chain by making a product that can be marketed. This makes water purification more profitable.





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Project: LIFE16/ENV/NL/000217 Waste2Kaamera

Demonstration of the extraction of the new raw material Kaamera from waste water streams

Coördinator	Rijn en IJssel water authority
Partners	Vallei en Veluwe water authority, Chaincraft, STOWA
Support	Delft University of technology, Royal HaskoningDHV
Total budget	€ 5,4 million
EU- contribution	€ 2,9 million
Duration	August 1 2017 till June 30 2023



stowa

Waterschap  Rijn en IJssel



WATERBEHEER: VEILIG EN OP MAAT





INTRODUCTION

The Dutch water authorities see contributing to a circular economy as an important social task. They have expressed the ambition to be fully circular by 2050. Indeed, water boards have resources and opportunities to make a substantial difference. They no longer regard residual and sewage water as waste, but as a valuable source of raw materials and energy.

An important core task of water authorities is the processing and treatment of residual and sewage water. There are great opportunities to recover raw materials during the treatment process of residual and sewage water. Recovery and utilization of energy and raw materials have therefore been receiving attention within the water boards for some time now. After initial pilots and studies, concrete follow-up steps are now being taken: new raw materials, in-depth research and innovation, and marketing.

One of the promising new raw materials is Kaamera.

Project LIFE16/ENV/NL/000217

The Kaamera project is pioneering and contributes to the EU strategic priority: transition to a circular and bio-based economy. The main goal is a successful demonstration of an innovative and attractive biobased value chain, which extracts the new raw material Kaamera from granular sludge produced in wastewater treatment. Because of its importance, the project received a contribution from the European LIFE grant program.

The main goals of the project are:

- successful establishment of a value chain for Kaamera (from source to end user!).
- 30% less sludge production, transport and treatment, resulting in a significant improvement in the ecological/economic footprint of wastewater treatment.
- Significantly lower energy consumption due to reduced sludge production and replacement of oil-based feedstock.
- Transferable project data, allowing this to be applied on a much wider scale.

The Kaamera project is pioneering and contributing to the LIFE is a European grant program that contributes to the realization of European environmental, energy and climate policies. For more information about LIFE; https://cinea.ec.europa.eu/programmes/life_nl



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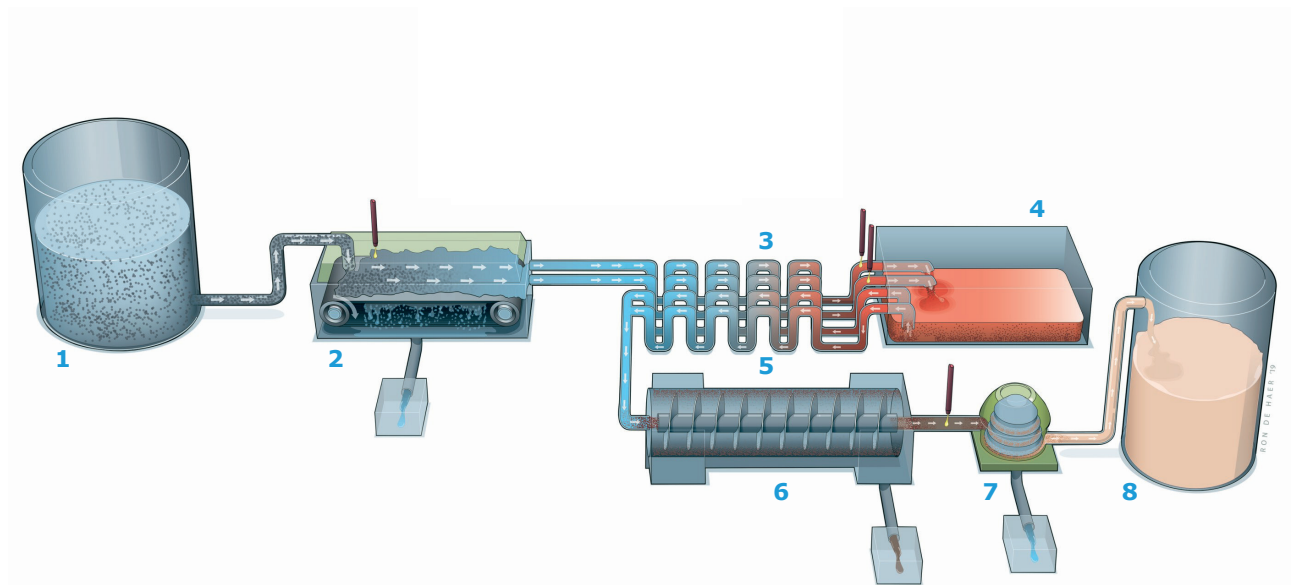
KAAMERA



Kaamera is a new biobased feedstock extracted from sludge pellets formed in the Nereda® treatment process. It can be used in many cases as a replacement for petrochemicals.

Kaamera is a biopolymer that can form a hydrogel structure; a pudding-like gel. It is produced by bacteria during the Nereda purification process. Kaamera is located around the cell walls of the bacteria in the sludge, making it the glue that holds the Nereda sludge pellet together, as it were.

The Rijn and IJssel and Vallei and Veluwe water authorities have built installations in Zutphen and Epe to recover Kaamera. Together with biotechnology company ChainCraft and knowledge institute STOWA, they carried out the LIFE project. Delft University of Technology developed the method to extract Kaamera from sludge. The extraction process takes place in eight steps shown in the illustration below.



- 1 Buffer with Nereda® granular sludge
- 2 Belt thickener reduces amount of water
- 3 Heat exchangers heat the sludge
- 4 Extraction reactor loosens Kaamera from the sludge
- 5 Heat exchangers cool the sludge
- 6 Decanter centrifuge separates water and the dissolved Kaamera
- 7 Disc centrifuge; the Kaamera flocculates as a kind of gel
- 8 Kaamera storage silo



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Adding value

By recovering Kaamera, we are adding value to the water chain. Kaamera can be a substitute for petrochemicals for several applications. This makes it a valuable raw material that we can market. As a result, water purification around the world can become more profitable and we are making an important contribution to the global need for circularity.

The name

Kaamera. It is a versatile name for a versatile product. Kaamera means “chameleon” in Maori, the language of New Zealand’s original inhabitants. The chameleon is known for its colorful transformation and adaptability.

RESULTS

Kaamera production

From the end of 2019, the Kaamera extraction installation in Zutphen, being the first plant in the world, started up. This went smoothly at times and sometimes there were unexpected situations that had to be resolved. As of the end of 2021, full-continuous 24-hour production was possible. A total of 400 m³ of Kaamera was produced. Since the fall of 2020, the second installation at the Epe location was also started up. This installation was soon able to operate fine. Due to minimal automation, this installation is not suitable for continuous production.

Kaamera is an amplifier and connector of properties. Kaamera can retain and repel water, it is fire retardant and is an excellent binder for composite materials, among other things. Combining Kaamera with another raw material changes the character of the fabric. This ensures that there are many possible applications.

Since its introduction, many promising products are being developed in the construction industry, in the world of new materials and composites and in agriculture, forestry and horticulture. Examples include the coating of fertilizers, which allows crops to absorb fertilizers better. As a result, less fertilizer ends up in the water or soil unnecessarily. As a coating of seeds, Kaamera ensures that the plants are more resilient and grow better.

Kaamera can also be used as a biostimulant, insulation material, fire retardant and glue and binder applications. The idea is that eventually residual and sewage treatment can take place cost-neutrally on a global scale.



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Some examples of applications and research

- In the forest near Loenen Falls, we planted 60 trees. Kaamera was mixed in some of the planting beds to retain moisture in the soil longer. In the first year, we saw a significant difference. The soil stayed at a good moisture level longer and significantly fewer watering moments were needed.
- Designstudio Omlab has developed a 3D printing paste that incorporates Kaamera and cellulose. With this they make building blocks and various other materials. Together with other parties, these applications are being tested for use in practice. On display during an exhibition at Museum de Fundatie in Zwolle (2021): a model of a bathroom, printed with the printing paste that also uses Kaamera. Later, this full-size bathroom was on display at the Floriade in Almere (2022).
- Amsterdam Institute for Advanced Metropolitan Studies has developed Re-plex, a composite material that incorporates Kaamera. Tests are taking place in watercourses in the Netherlands. The honeycomb structure gives young aquatic plants the support they need to root properly. Over time, the support is no longer needed and the biobased material will break down.



THE CHALLENGES

Kaamera's development is experiencing challenges:

- Problems with laws and regulations. Obtaining End of Waste status is a difficult process that is also not straightforward.
- The public task of purifying water clashes with the private task of product supplier.
- Exploratory talks have taken place with more than 80 potential customers. These showed that in order to convince markets of the Kaamera product, sufficient certainty of product delivery and product quality is essential.

ENVIRONMENTAL IMPACTS

The environmental impacts of Kaamera are highly dependent on the application (which fossil-based material is replaced by Kaamera). A life cycle analysis was conducted, comparing Kaamera to a limited number of other materials used in current products.

In its function as a binder in manure, the application of Kaamera has a clear advantage on climate impact as a substitute for commonly applied substances (converted to CO₂ 45 times less emissions). Even if Kaamera replaces alginate from seaweed, Kaamera has a clear environmental advantage (converted to CO₂ 12.5 times fewer emissions).

In addition, the production of Kaamera requires less sludge to be disposed of. This has financial benefits for the water authorities, but also reduces transport movements.





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COST ASPECTS

In Kaamera extraction, capital costs are relatively high and operating costs are relatively low. Thus, the sales volume has a very significant impact on the cost price.

One multi-year supply contract has been signed so far. A viable business case for different value chains seems possible, but more dedicated and specialized market development must first take place. The combination less cost, more revenue should in principle lead to water treatment becoming more profitable. This is, however, a matter of the long haul. The Kaamera project has shown that there is a lot of potential to achieve good sales in the long run and thus to make the treatment of residual and sewage water more efficient and more circular.

TRANSFERABILITY OF PROJECT RESULTS



The project has demonstrated that Kaamera extraction is technically/technologically suitable for large-scale application in the treatment of both domestic and industrial wastewater at Nereda® treatment plants. Furthermore, it has been demonstrated that Kaamera extraction is also possible at other Nereda® plants in Europe (Scotland, Portugal).

This means that Kaamera recovery is suitable for many more plants in Europe and around the world.

With a mobile Kaamera installation, extraction was tested in local conditions in Utrecht and Faro Portugal

The knowledge and experience gained can be usefully used in the design of new Kaamera extraction plants. The extensive research program has yielded several optimization opportunities that can be exploited in future designs.

Introducing a new product into existing markets (replacing fossil alternatives) and developing new value chains require a strong commitment and emphasis on market and product development. It appears that convincing the market of the product and its quality is of primary importance.

Clear positioning in the market is necessary. End users will want to purchase Kaamera only if long-term sustainability can be guaranteed and the costs are lower than existing alternatives.

For successful implementation, cooperation within the sector, but also with parties outside the sector, has proven essential. Multiple parties (such as science, knowledge institutes, industry, market parties, water boards and other governments) have interests and have made important contributions.

The raw material Kaamera is still in the introductory phase; as we go along, we should gain more insight into its composition, application possibilities and sales opportunities. In part, this is still a search process. In order to move forward with this and achieve results, solid cooperation is needed. The cooperation requires a lot of attention and strength and needs the knowledge, experience, financial resources and network to generate sales. The focus is on developing products with the functionalities the market needs.



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SUMMARY

Waste2Kaumera successfully demonstrated a new and innovative value chain for granular sludge produced in wastewater treatment. By recovering Kaumera from sludge and valorizing a value chain of biobased products, the project succeeded in adding value to industrial by-products and wastewater that are currently unexploited and even disposed of.

Specifically, the project extracts Kaumera from granular sludge at two Kaumera Extraction Installations (KEI) at the Zutphen and Epe sites.

The extracted Kaumera is valorized into marketable products for various sectors. The technology is implemented on a semi-industrial scale that produces Kaumera when there is a market demand. So far, one multi-year supply contract has been signed. A viable business case for different value chains seems possible, but more dedicated and specialized market and product development needs to take place. Production volume and product quality are essential prerequisites here. Moreover, problems encountered in the area of laws and regulations and public/private tasks must be properly resolved.

OUTLOOK

With the urgency and ambition for sustainability and circularity in mind, an exploration of the possibilities for scaling up Kaumera beyond the LIFE project was recently undertaken. This is an essential next phase. More product development is needed to achieve more production and thus sales. In addition, expanding cooperation with several water boards leads to scale optimization, support and attracting more potential market players.

Therefore, there is now a proposal to form a cooperative of 6 water boards in which the production of Kaumera will be placed. In addition, there is the intention to establish a start-up BV for market and business development. In this, the aforementioned cooperative and a company involved are equal partners. Final decisions on this are expected in late 2023, early 2024

INFORMATION

For more information, visit www.kaumera.com
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