Layman's Report









LIFE EMU NEW - LIFE14 ENV/PL/000370

Project:

"Pro-ecological pilot installation for bituminous emulsions production, modified with polymers waste nanostructures"





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1. PROJECT DATA

Project number		LIFE14 ENV/PL/000370
Full name of project	3	Pro-ecological pilot installation for bituminous emulsions production, modified with polymers waste nanostructures
Project starting date	3	1 August 2015
Project completion date		31 December 2019
Total project implementation period	3	53 months
Total project budget	3	4 445 095 €
Funding requested from IKE	3	2 628 123 €
Requested co-financing from NFEP&WM	③	657 030 €
Project beneficiary	③	Flukar Sp. z o.o
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2. SUMMARY

The implementation of the project started on 1 August 2015. This report is the final report, covering the entire project duration from 1 August 2015 to 31 December 2019.

The objective of the project was to use polymer waste for asphalt emulsions. Pro-ecological pilot installation for the bituminous emulsions production, modified with waste polymer nanostructures (abbreviated as LIFE EMU NEW) is a project developed by a team of experts from Flukar Sp. z o.o. It is an innovative concept of a technology that was to contribute to solving environmental problems related to polymer waste management. Due to the large scale production of asphalt emulsions and their wide use in road construction, it is a very useful way of recycling polymer waste. All tasks were executed in accordance with the intended objectives of the project, which enabled efficient implementation and monitoring of the project progress. The result of the project was the construction of an installation for the production of asphalt emulsions modified with waste polymer nanostructures, including:

- Modified asphalt production node
- Liquefaction and modification of waste polymers node
- Modified asphalt production node
- Production and storage of nanofibres node

The next stage was to test and validate the technology on an integrated prototype and conduct consistent promotional and informational activities among the target groups of the project. A number of demonstration activities were also carried out to demonstrate the technology through channels - including press releases, debates, films, etc. - in order to raise public awareness of the potential of nanotechnologies and innovative technologies in the road and construction sectors.

This has resulted in the introduction of new asphalt emulsion products with better strength and performance characteristics than those currently used in road construction.











Fig. 1 Installation elements on site

3. PROJECT OBJECTIVE

The main objective of the project was to demonstrate the functioning of an innovative technology for the production of asphalt emulsions modified with polymeric recyclate and mineral nanofillers.

IMPLEMENTATION OF A PROTOTYPE AND PILOT INSTALLATION CONSISTING OF 4 TECHNOLOGICAL NODES:

- Modified asphalt production node
- Nanofiber production node
- Liquefaction, purification and modification of waste polymers node
- Emulsion production node













4. TECHNOLOGY

The installation is designed to produce, in a continuous process, modified asphalt and asphalt emulsions as final products.

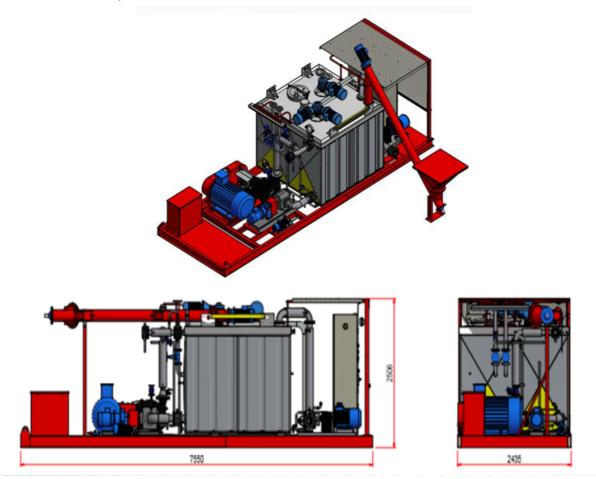


Fig.2 Installation components of asphalt emulsion plant

The process of obtaining products consists of:

modified asphalt: mixing of base asphalt with a polymer modified with a mineral nanofiller.

asphalt emulsion: dispersing the modified asphalt in a previously prepared aqueous solution. The main elements of the installation for production of asphalt emulsions modified with waste polymer nanostructures are four technological nodes:







modified asphalt production node

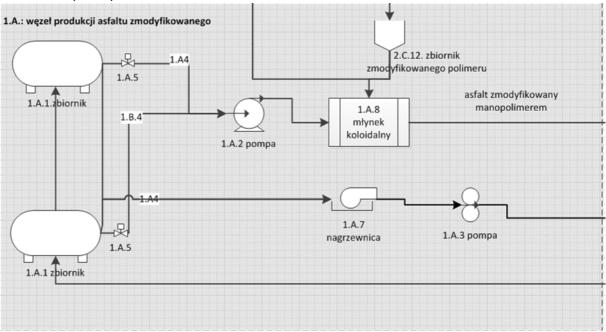


Fig. 3 Conceptual diagram of the modified asphalt production node

liquefaction, purification and modification of waste polymers node

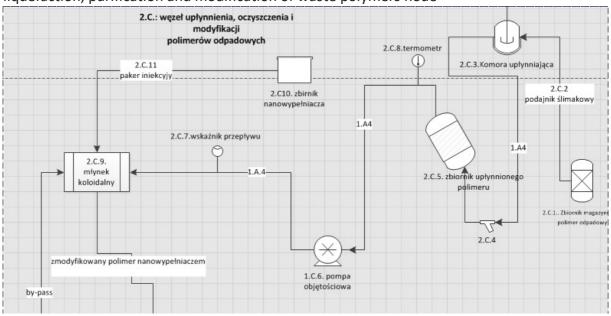


Fig. 4 Conceptual diagram of the liquefaction and modification node for waste







nanofiber production node

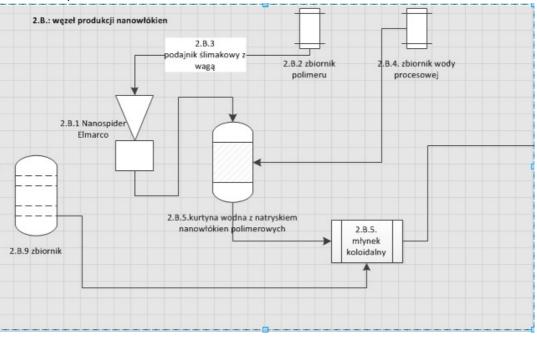


Fig. 5 Conceptual diagram of the nanofiber production node

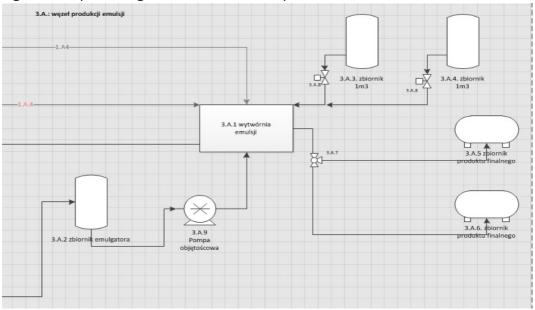


Fig. 6 Conceptual scheme of nanofiber-modified emulsion production node







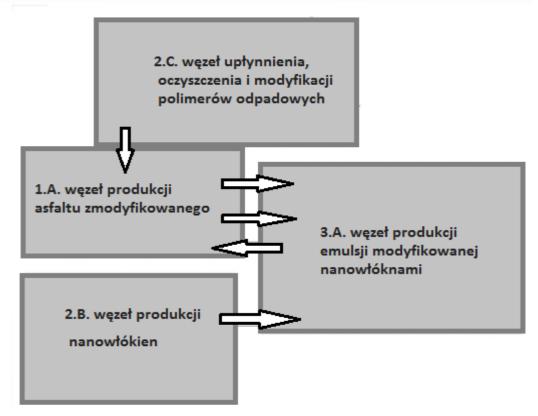


Fig.7 Conceptual diagram: interrelationships between nodes of co-production installations of asphalt emulsions modified with waste polymer nanostructures



Fig. 8 Pilot installation for the production of asphalt emulsions modified with waste polymer nanostructures















Fig. 9 Pilot installation for the production of asphalt emulsions modified with waste polymer nanostructures













5. IMPLEMENTATION OF PROJECT GUIDELINES AND OBJECTIVES

THE OBJECTIVES WERE PURSUED THROUGH THE FOLLOWING ACTIONS:

5.1 Refining the technical concept and developing project documentation

This process was divided into three stages:

STAGE 1

 included the verification of the correct selection of asphalt for use in the technological process. The action was completed with a report in March 2016

STAGE 2

• including the clarification of parameters of selected types of waste polymers and mineral fibres together with the verification of the emulsifier, completed with the report in April 2016

STAGE 3

• consisted in the development of the general technical concept of the pilot installation - the elaboration of the concept of the waste polymer liquefaction chamber taking into account the results obtained in the implementation of Stage 2 . This stage was completed with a report prepared in June 2016

DETAILED DESIGN • Complete technical documentation was prepared. The detailed design went through three reviews: the first one in November 2016, the next one in October 2017 and, during the last review in April 2018 it was approved for construction

5.2 Construction and start-up of the pilot installation

Construction of the pilot installation started in Q1 2018 and lasted until Q2 2019. In Q1 2018, contracts were concluded with equipment suppliers and some supplies of elements of the prototype pilot installation were made. In Q2 2018, construction documentation was analysed in terms of location of main equipment and accessories. In Q3 2018, earthworks were













executed, a park of tanks was built, access roads, a hall was prepared for the assembly of elements of the pilot installation, and further elements of the pilot installation were delivered. In the last quarter of 2018, storage tanks for asphalt and modified asphalt were delivered, complete pipelines and fittings, the connection of individual devices to electricity was made, all components of individual devices and equipment were combined, part of the power supply and automation installation was made, all pumping devices and loading and unloading station were installed. In Q1 and Q2 2019 the assembly of devices in all installation nodes was completed, tanks and their piping was completed. The tightness tests of the installation were performed. Preparations for commissioning were initiated.





































Fig. 10. Construction of the pilot installation for the production of asphalt emulsions modified with nanostructures from waste polymers













The first commissioning of the pilot installation took place in June 2019. It required the presence of the supplier or manufacturer of the equipment or component. First of all, due to the innovative and pilot character of the installation, commissioning needed to be familiarized with:

- the operation of individual devices
- the way the devices were connected to each other
- the specifics of asphalt modification as well as safety issues related to its unloading/loading and heating
- the specifics of polymer use.

As part of the first start-up of the prototype installation:

- the correct assembly of all the systems was checked based on technical documentation
- leakage tests were performed at all the nodes
- successively, the operation tests were performed with positive results
- the system was filled with thermal oil and heating oil. The boiler was started up
- asphalt transport was received the tanks were filled by way of the delivering truck's built-in unloading and loading system
- the raw material was milled using an extruder.

Eventually, all the equipment was put into operation and calibrated in order to operate properly and increase its efficiency. The specificity of the installation brought with it a number of problems that the team of Flukar Sp. z o. o. employees had to deal with.

5.3 Testing and evaluation of technology on a pilot scale

Between the months of July and December 2019, a number of pilot installation start-ups were performed. Initially, the commissioning concerned individual devices, then entire nodes, and finally the operation of the entire pilot line was tested and validated.

Thanks to quick employment and/or secondment of staff, a team specializing in the launch and operation of the pilot line was created. Having a development and research centre with a dedicated laboratory for testing asphalt and asphalt emulsions on site, it was possible to immediately test the first products produced by the installation. This





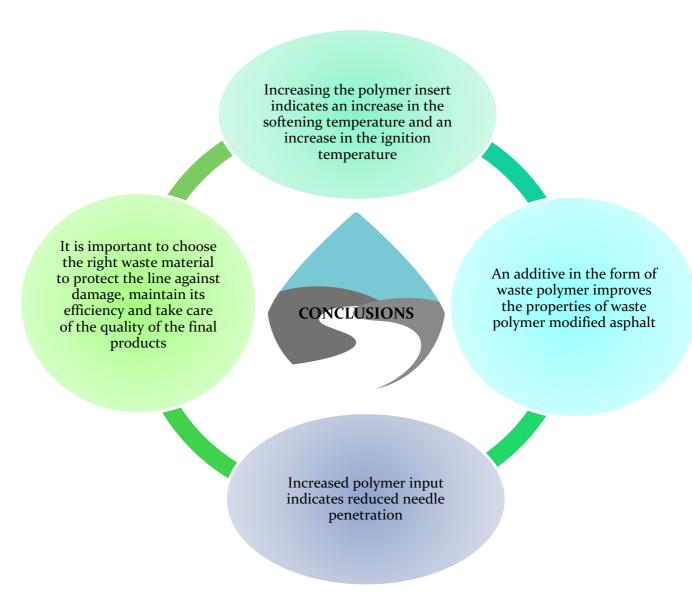








increased the efficiency of the validation, as it was possible to react quickly to the characteristics of the final product by, for example, changing raw materials.









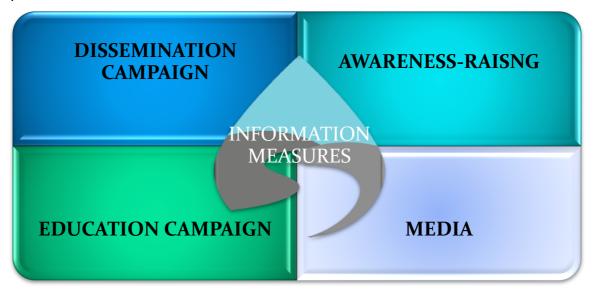






5.4 Performing a complementary cycle of information activities targeted at entities potentially interested in implementing the presented technology.

Information and promotion activities were implemented throughout the whole project duration. It should be noted, however, that the second half of 2019 allowed for the intensification of factual discussions on the project products and results. A number of activities were carried out within the project to disseminate ideas related to environmental protection, in particular waste reuse. The activities were focused on several parallel and interlinked campaigns. For all information and promotion activities, a creative line and a graphic key for the whole project were developed, which is still used today.



EDUCATION CAMPAIGN

This campaign was primarily targeted at:

- contractors, installation subcontractors
- raw material suppliers
- company employees
- members of the project team and the consultative committee
- company's existing customers
- the inhabitants of Kędzierzyn-Koźle.

The most frequent activities include e-mail communication as well as working and official meetings of the project team members with representatives of the above mentioned groups, and among themselves. This communication ensured the exchange of information, including











familiarization with the technical documentation of the installation, as well as discussions on the next steps within the project, decisions to carry out further tests or select the raw material.



Fig. 11 Educational meetings/consultation of project team members

AWARENESS-RAISING



Fig. 12 Information campaign during the fair in Poznań

The inter-sectoral debates and information meetings were an important form of this campaign. Thanks to the exchange of experience and information on world-renowned technologies using waste to improve other products, participants' awareness of the direction the world is now taking has increased. The zero-waste lifestyle as well as the idea of recycling are becoming more and more widely known to ordinary people. Due to the nature of the project, it was not possible to organise individual debates for the originally planned number of participants, because in order to be able to talk about the problems of the project













concretely and on a high level of substance, it was necessary to focus on engaging in events that had been known for years, which guaranteed the presence of people with the appropriate reputation and knowledge. A much better solution (more effective in terms of the ratio of expected result to costs) was the presentation of the project idea at events already organized.



Fig. 13 Our specialist delivering a speech during the 10th Europe-Ukraine Economic Forum 28 January 2017

Representatives of Flukar participated, among others, in the Inaugural Conference 19 November 2015 / Krosno, Małopolska Intersectoral Debate 26 February 2016 / Cracow, Life Information Day 26 April 2016 / Warsaw, Silesian Intersectoral Debate 07 October 2016 / Przyłęków n. Żywiec, I International Debate 13 January 2017 / Liptovský Mikuláš /Slovakia, 10th Economic Forum Europe-Ukraine 28 January 2017 / Rzeszów, CHEMIKA EXPO 2017 Conference / Szczecin, Life Information Day 25 April 2017 / Warsaw, 7th Construction Chemical Industry Conference, Warsaw 3 December 2019. Post-conference materials are available at https://www.emunew.pl/pl/materialy-pokonferencyjne/.















Fig. 14 Project representatives during conferences and information days

DISSEMINATION CAMPAIGN

The dissemination campaign was realized mainly via website and social media, as well as through all kinds of information materials - leaflets, folders and promotional gadgets distributed at various events in which Flukar Sp. z o. o. participated and during which Flukar promoted other activities of the company. Social media occurred to be the most effective medium for conveying news and content.



Fig. 15 Flyers and promotional gadgets











Fig. 16 Project profile in social media

Among other things, three project newsletters were issued (available at https://www.emunew.pl/pl/materialy-informacyjne/).



Fig. 17 Project information bulletins







Also, publications were released, such as: *Magazyn Chemia i Biznes* No. 3/2018 "Asphalt emulsions and their functions in the road industry", *Magazyn Chemia I Biznes* No. 5/2017 "Research on obtaining polymeric nanofibres by electrospinning", *Magazyn Drogownictwo* No. 7-8/2017 August 2017 "Production of innovative asphalt emulsions. Risks and opportunities for development", *Magazyn Autostrada* No. 10/2016 October 2016 "Double modified asphalt emulsion - innovations and benefits", *Magazyn Wiadomości Naftowe i Gazownicze* No. 5.6 (216) May/June 2016 "Asphalt emulsions modified with nanostructures made of waste polymers - an innovation in road construction and an opportunity for the environment", *Magazyn Chemia i Biznes* 5/2018, "Improving Life Emu New technology in the new research and development centre Flukar.", *Magazyn Chemia i Biznes* 1/2019, "Ecoinnovation on a global scale" (available at https://www.emunew.pl/pl/nasze-publikacje/).

A documentary film was made as part of the project. The content and form of the film were tailored to the widest audience. Following conversations with marketing and advertising specialists, a film lasting just about 5 minutes was created, thanks to which the viewers are not bored, and the documentary is also suitable for fairs and workshops. The film was uploaded on Youtube.com on EMU NEW channel in two language versions. Then the link to the film was distributed through various channels among distributors, customers, employees etc. The information video about the project can be viewed on the website: https://youtu.be/rtn-puwQrss.



LIFE EMU NEW. Ecological bituminous emulsion

Fig. 18 Information film about the project













MEDIA

Promotional and informational activities were noticed by the media, which influenced the dissemination of information about the project, among others via the information service lokalna24.pl about the international debate which took place at the Instituto Superior de Engenharia do Porto: 28 March 2019 – a Polish company presents innovative technology in Portugal, LIFE Lugo+ Bio Dinamico:28 May 2019 - "O proxecto LIFE EMU NEW visitara Lugo en Xuno", Chemia i Biznes: 08 December 2017 - "5th Construction Chemicals Conference: specialists discussed the situation of the industry", SzczecinBiznes.pl: 4 April 2017 - "How to money from scientific ideas? - summary of the CHEMIKA Forum EXPO 2017, 22 February 2017 - "CHEMIKA EXPO 2017: in Szczecin on the chemical industry" - announcement of CHEMIKA Forum EXPO 2017, information service Nowiny. 24 about the Life Emu New project: "LIFE EMU NEW - Pro-ecological installation for production of modified asphalt emulsions", economic portal wnp.pl about the Life Emu New project, terazPrudnik.pl: Pro-ecological pilot installation for the production of modified asphalt emulsions, czytajRzeszów.pl: Asphalt from plastic waste? Global innovation of a Polish company, Nowiny Nyskie: Innovation on a global scale. A Polish company will build a pilot installation for the production of asphalt emulsions. (all materials are available at https://www.emunew.pl/pl/o-nas-w-mediach/)

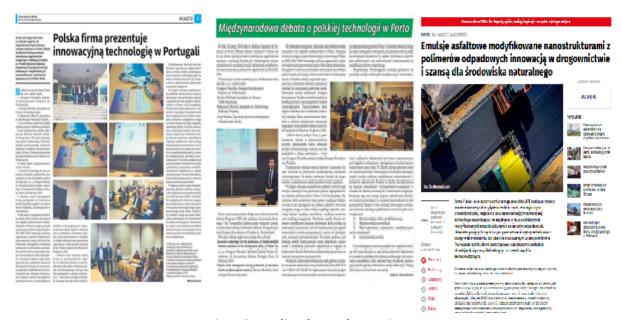


Fig. 19 Media about the project







5.5 Theoretical and practical presentation of technology

Activities based on demonstration workshops conducted in the last six months of the project proved to be an invaluable tool. People from the industry - technology suppliers, representatives of engineering companies, as well as people completely unrelated to the industry - were invited to the workshops. Thanks to this, the workshops were very diverse in terms of their content. Both the language of speech and the amount of knowledge were adjusted to the recipient sitting in the room on a given day.

Thanks to the location of the pilot installation close to the Research and Development Centre, the workshops could take place in three stages:

- 1. information meeting in the R&D conference room
- 2. demonstration of the installation in the hall
- 3. visit to the laboratory (asphalt testing laboratory) combined with a discussion on the parameters of raw materials in relation to the expected quality parameters of final products possible to achieve on the installation.

Another educational activity was the development and placement in the hall of boards showing the scheme of operation of the pilot line, as well as marking the elements of the line with information on the project co-financing. The diagrams facilitate the conduct of workshops - especially for people with little industry knowledge.















Fig. 20 Demonstration workshops and grand opening of pilot installation

6. ENVIRONMENTAL CHALLENGES AND BENEFITS OF THE PROJECT

As part of the development and implementation of the innovative technology for the production of double-modified asphalt emulsion, FLUKAR experts have anticipated a number of solutions aimed at achieving positive environmental effects. The project has a positive impact on the environment by introducing ecological processes and products. It uses waste in the production process, while saving energy and natural resources.

Polymer waste recovery

Although plastics are fully recyclable, only a fraction of their waste is currently recycled. In Poland, the annual consumption of plastics, in all areas of application, is about 60 kg per capita, of which only about 10% is estimated to be recovered. The use of waste materials will also have a very positive impact on the natural environment. Bearing in mind the expected consumption of asphalt emulsions and assuming the average share of polymer waste in the modification of asphalt binders at the level of about 12-15%, it is possible to manage polymer waste at the level of 15 thousand tons per annum, which at the same time will minimize the amount of waste directed to landfills or incineration plants.













Minimising the amount of used asphalt

In the production of 3259 kg of modified bitumen, 293 kg of polymer waste is used, in addition to improving the parameters of bitumen, (293 kg/3259 kg =) 9% of bitumen is used, which indirectly translates into lower consumption of crude oil. This effect is based on reduced consumption of crude oil (asphalt production) and use of polymers (reduced demand for oil components).

Minimisation of natural resources consumption

The reduction in crude oil consumption is due to lower asphalt consumption. This effect is also based on the use of polymers, which also reduces the need for oil components. The introduction of polymer nanofibres also produced from waste polymers to the final stage of asphalt emulsion production has resulted in an increase in low-temperature resistance, which is one of the main reasons for the top layers of the road surface to be decoupled and will improve mechanical-elastic properties in the longitudinal and transverse directions. The life cycle of an asphalt pavement built with innovative technology will increase by 30%, resulting in the minimisation of the amount of asphalt used and thus improving road safety.

Reducing energy consumption

The process of production of polymers from crude oil requires higher energy consumption than the process of liquefaction of waste polymers used in modified asphalt production. Taking into account the amount of asphalt emulsions produced, the application of this technology contributes to significant energy savings.









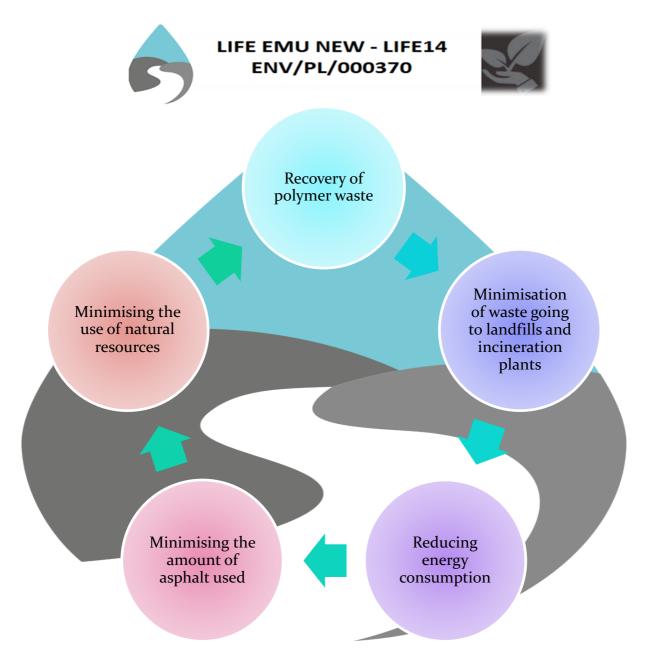


Fig. 21 Beneficial environmental effects of the project

7. AFTERLIVE - ACTIVITIES AFTER PROJECT COMPLETION

At the end of the project, the project team and the management decided to suspend the decision to commercialise the products obtained by using the technology tested on the pilot line. Further tests combined with laboratory tests will be conducted. Production of emulsions on a smaller scale will be carried out as required.







The next steps will be focused around:

searching for and purchasing raw materials, conducting further tests on various raw materials, including further attempts to use nanofibres effectively

research of obtained products, development of optimal quality parameters

observation of the legal environment with regard to changes in the Public Procurement Law or others forcing public institutions to change the criteria in tenders for the supply of asphalt and asphalt emulsions

seeking an additional way to use the pilot installation for all activities related to closed-loop management; as a complement to the plant for recycling of used oils and production from the resulting raw material - base oils, oils, lubricants, asphalt emulsions

further educational, information and dissemination activities focused on raising awareness and creating a pro-ecological attitude

monitoring of indicators using waste polymer - based on raw material purchase - in a capacity range of 176 t/year

Due to the conclusions from the actions taken so far, the implementation of these objectives will include in particular - employees, persons directly cooperating - business partners, suppliers of raw materials, contractors. For reasons of efficiency, the tools













most frequently used during the project implementation will continue to be used for educational, information and dissemination purposes:

- participation in industry information meetings, debates and conferences (as participant and speaker) including events related to the chemical industry, environmental protection, new technologies in waste management;
- workshops/trainings for employees, collaborators, product distributors, customers and other groups with whom Flukar Sp. z o. o. maintains business relations;
- informational activities in the form of social media and other marketing activities publishing information about the plant's activities especially in the field of waste management, recycling, environmental protection;
- publishing interesting information about new technologies in the field of waste management on company profiles in social media.

8. CONCLUSIONS

In view of the results of the performed tests, it has been established that:

- the pilot installation enables the production of waste polymer modified asphalt
- in order to ensure the maintenance of the installation as well as the quality of the final product, the quality of the waste polymer must be observed during the selection process
- at the time of project completion, the results confirm that the obtained modified asphalt emulsions meet the requirements and expected parameters
- the long-term and most important effect of the LIFE EMU NEW project executed by Flukar Sp. z o. o. is a change in the company's profile: from a standard manufacturer of lubricants and oil, the company has become one with its own research and development facilities, a company based on the idea of closed-loop economy. In addition, thanks to other investments, it has been possible to maintain the company's original business profile with a modified environmental factor, thanks to which the company will not use natural resources, but will manage the waste and recycle it on many levels, including using a pilot installation;
- the mentality of the management board, employees and business environment has changed profoundly. Flukar Sp. z o. o. is a company caring about the environment, wanting













to build its capital without damaging the natural environment and even making it easier to protect it.









