Using dust to make costs disappear: Energy from waste

Disposing of waste is an expensive process. In the future, companies could save on disposal costs and reduce heating costs - by using an incineration plant for powdery waste material. Together with an industrial partner, researchers at the Fraunhofer Institute for Factory Operation and Automation (IFF) in Magdeburg have developed a system for the thermal recycling of inflammable powdery industrial waste. A discussion with Dr.-Ing Matthias Gohla, Process and Plant Engineering Business Unit Director, supervisor of the IFF project in Magdeburg.

In a word, what have you invented?
Dr.-Ing. Matthias Gohla: Our project group has developed a system that offers new and patentable solutions. It is based on dust firing technology. Of course, there are dust burners already on the market, but we have modified them in such a way to enable an industrial residue with certain properties to be used. One example of this is provided by low-melting powder residues. These powders are particularly used for the coating of metallic materials. If you would like to thermally use such residue powder, then its low-melting point property is somewhat counterproductive. If this type of powder is inserted into a furnace, it will melt extremely quickly and caking will result. Then you are faced by the big problem of feeding it into a burner. The development behind it is this: we have developed a burner, in which this powder does not come into contact with a hot wall, but is fed into the furnace in a stream of gas. The burner and the combustion chamber are designed with digital engineering methods in such a way that caking does not occur.

So you haven't re-invented the wheel, but incorporated an innovation? Dr.-Ing. Matthias Gohla: Continuing with the analogy of the wheel, one might say that if Mr. Dunlop invented the pneumatic tyre for the wheel, then we have developed something comparable to the tyre for dust-fired furnaces.

How did you come up with this idea?
Dr.-Ing. Matthias Gohla: We were approached by a customer from the timber and metal industry, who uses a powder coating plant and also requires heat in the coating processes. He cannot deposit the powdery residue anywhere, and disposing of it is very expensive. He asked us if there was anything we could do. Our response was to undertake this path of development.

How can the plant be described?
Dr.-Ing. Matthias Gohla: What we have now is a small-scale pilot plant capable of generating a thermal output of 100 kilowatts. This roughly corresponds to the heating power required for six single-family homes. The plant has a two by six metre base and consists of three basic units: the combustion chamber containing the powder residue burner, the heat extraction unit and the made-to-measure gas purification facility. The powder waste is pneumatically directed into the burner - i.e. by using compressed air. There it is systematically swirled, brought into contact with combustion air and burnt. The heat created is stored in water, which is then used for drying processes. The waste gases created during the burning are suctioned off and cleaned in a filter system.

Are similar plants already in existence?
Dr.-Ing. Matthias Gohla: Of course, different principles of dust firing already exist, particularly for large power plants. I am not aware, however, of any small-scale industrial dust burning plants that use this special fuel. This is an entirely new concept.

Would this enable you to capture national and international markets?
Dr.-Ing. Matthias Gohla: Yes, that is indeed our intention. We have, of course, only a limited market potential in the area of powder burning. An estimated 20,000 tons of residue powder has to be disposed of in Germany each year. There are, however, other combustible dusts occurring as residues - for example, fine dust in the timber industry or sanding dust from paint stripping.

How long have how many employees been engaged in this research?
Dr.-Ing. Matthias Gohla: Two process engineers and one design engineer have been working on this project for approx. two years. Tests have been conducted at trial plants, while the plant was built in Magdeburg and tested in trial operation. It was then delivered to the customer and is now in the pilot testing phase for the purpose of optimising the operation.

What foundations have to be laid in order to tackle this project in general? Dr.-Ing. Matthias Gohla: We have bundled the expertise here in our institution. We are process developers in the field of thermochemical energy conversion plants for solid fuels. We possess process engineers for process development and process design as well as system engineers to write the process control software. Plus we have scientists to create the simulation models and calculation methods, by which means we discover whether it is really possible to build a plant like this one. Therefore it wasn't necessary for us to create these requirements as they already existed in our institution. We did, however, have to develop know-how for this special process. Another key factor was to gain insight from the actual operation of the plant, and modify it on a targeted basis.

Can the plant be used yet?
Dr.-Ing. Matthias Gohla: The prototype has been in normal operation since the beginning of the year at a company specialising in powder coating. We are therefore in the test operation stage and thereby optimising the plant. However, we can in principle state that the plant has achieved market maturity. Actually though, it is necessary to qualify that statement a little - for each special fuel used, the plant has to be redesigned and adapted. In other words, such a plant is invariably a made-to-measure plant.

Is the plant suitable for all companies?
Dr.-Ing. Matthias Gohla: As a matter of principle, any company possessing combustible fine dusts can make use of this technology.

What benefits are there for companies using this plant?
Dr.-Ing. Matthias Gohla: In a nutshell, every company using this plant will save on disposal costs. Furthermore, the plant also generates energy, which can be used by the company for heating as process heat for production processes. '

What other research projects involving energy and resource efficiency are you working on?
Dr.-Ing. Matthias Gohla: There is in our institute the innovation cluster "Energy and resource efficiency in value-creation chains in industry" - or ER-WIN for short, especially tailored to Saxony-Anhalt. It is precisely this cluster that is intended to drive the development of resource efficiency forward in this state. We are also working on such projects both nationally and internationally.

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Caption: Dr.-Ing. Matthias Gohla, Process and Plant Engineering Business Unit Director at the Fraunhofer IFF in Magdeburg.

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