



MethaPlus®

Bright Science. Brighter Living.

Why MethaPlus®?

MethaPlus® is an enzyme containing product that can be used as a processing aid. It was specially designed to enhance and stabilize biogas production processes using fiber rich feedstocks.

Why use MethaPlus® in your biogas installation?

It has been documented and proven that enzymes help you to enhance your process and to improve your biogas production economics. With more than 100 years of experience in enzyme production and application we are well equipped to support you in using enzymes. We are proud to be your enzyme supplier and are more than willing to assist you in optimizing your biogas operations. Looking for process support? Look no further: ask DSM to take a look inside your fermentor.

In this document we tackle a number of Frequently Asked Questions on enzymes, their features and their use.

Why use MethaPlus®?

MethaPlus® has been especially designed for biogas production processes using fibrous substrate.

MethaPlus® is presented to you as preferred liquid (or optional micro granulated product). The format presented to you is chosen such that with a fair dose maximum effectiveness can be reached. Not too small amounts needs to be used for it to be easy to mix over the quantity of substrate, fair priced and have a great effectiveness ratio.

MethaPlus® is the only biogas enzyme that has proven its effect in over 30 full scale field trials.

MethaPlus® was introduced in 2003 to the German biogas market it has not been surpassed for its cost in use ever since.

MethaPlus® efficacy in the field trials was expressed in several ways. Every biogas plant uses different substrates and runs under different conditions. The effect of **MethaPlus®** is routinely confirmed on fibrous substrates in combination with manure.

To the best of our knowledge based on theoretical interpretations and practical fact collections there are no limitations to use **MethaPlus®** in biogas production processes. No negative effects have been reported on the digestate quality and quantity.

Documented effects in the **MethaPlus®** field trials:

- More methane gas output
- Better substrate conversion
- Increased process stability
- Higher dry matter/organics loading
- Improved digestate (liquid solids) separation
- Shorter fermentation/residence time
- Less digestate transportation costs
- Less raw material usage
- Reduced viscosity
- Less electrical energy usage (pumps)
- Less floating/sinking layers
- Reduced risk on stirrer, pump and pipe blockage

Key-driver in biogas business is an increase in biogas yield.

In field trials with **MethaPlus®** this varied from 4 to more than 30% yield improvement. On average we see a documented 10 to 15% yield improvement.

More than 100 years of enzyme experience in many applications has led to the development of **MethaPlus®**. The next generation of **MethaPlus®** alike products is under development and is already being tested in some biogas plants in the German market. These developments aim at other, new substrates for use in biogas installations.

DSM works with regional and local resellers to ensure that the product is in stock close to your facility. Check www.dsmbiogas.com for your nearest reseller.

What is an enzyme?

An enzyme is a natural protein and can be found in people, plants, animals and microorganisms. Enzymes catalyze and regulate nearly all biochemical reactions that occur in living organisms like your body. Their main function is to hydrolyze polymer molecules (substrate) into smaller polymers and ultimately into monomers (product). These monomers serve as nutrients for (micro) organisms to survive, live, grow or multiply.

What is enzymatic hydrolysis?

Hydrolysis is a natural breakdown process in which enzymes act as a catalyst. Enzymes are also called 'nature's scissors': they cut the natural fiber (polymer) into smaller fractions, and ultimately monomers.

What is a biocatalyst?

Catalysts perform a specific task in a chemical reaction without being consumed or destroyed. Biocatalysts do the same in biological processes. Enzymes are biocatalysts: they perform their task eternally, unless they are inactivated by heat, pH or alike.

What is a polymer, and what is a monomer?

In nature the plant backbone (wooden structure) is built from among others the sugar polymer cellulose. Enzymes, called cellulases, can break down cellulose into glucose monomers. Other examples of natural polymers are starch, built from sugar monomers, which are to be addressed by amylases. An other polymer example would be a protein, built from amino acids as monomers to be broken down by proteases.

What is a processing aid?

Processing aids perform their task until all substrate has been consumed. As soon as new substrate becomes available, they can act again. Enzymes in biogas industry are processing aids, which means they play an active role in hydrolyzing natural polymers.

Why use enzymes?

Enzymes bring a wide range of processing benefits and ensure cost savings by:

- improving processing efficiency
- reducing production time
- replacing physical and chemical treatments
- reducing energy needs
- using less raw materials

How are enzymes produced at DSM?

All living cells, including the cells in your own body as well as microorganisms, produce a.o. enzymes. During the last more than 100 years DSM has developed experience to maintain, culture and grow microorganisms such, that they produce enzymes for use in large quantities. These enzymes are extracted and purified from the culture media and then stabilized into a product which is offered to the biogas industry.

Do GMO enzymes exist?

GMO stands for Genetically Modified Organism. An enzyme is a protein and not an organism. Therefore an enzyme is never a GMO. There are two points to consider here: enzymes can be produced by genetically modified microorganisms, and enzymes can be protein engineered, which means that changes are made in their amino acid composition, in order to increase e.g. their stability under different pH or temperature conditions. These changes are normally made in the DNA of the microorganism to allow them to make the modified protein (enzyme).

MethaPlus® is an enzyme produced by a natural microorganism. This organism, a fungus, was selected from various fungi growing on substrates that are rich in cellulose / fiber and optimized using conventional methods.

What is enzyme activity?

Enzyme activity is a measure that can be expressed in a defined amount of substrate to be hydrolyzed in a defined amount of time. For every enzyme (type, supplier, product) the activity is defined differently. Unfortunately enzyme units between different products cannot be compared one on one. In order to compare activity of commercial enzyme products, they need to be measured next to each other under the same test conditions.

What is enzyme stability?

An enzyme is a protein (polymer) composed from a chain of amino acids (monomers). Any protein, and therefore also any enzyme, is sensitive to changes in its environment like temperature and/or pH. For example: the proteins in an egg irreversibly become white (denatured) and solid after boiling. Enzyme stability as such largely depends on environmental conditions. In general, enzyme products should be protected from heat (e.g. direct sunlight).

How to stabilize enzymes?

Two types of stability need to be considered:

- 1) Microbial stability of the product: microbes that grow in the enzyme product can theoretically "eat" the proteins (including the effective enzymes/cellulases in **MethaPlus®**) present in the product. Although DSM has formulated **MethaPlus®** such that microbial contamination is hardly possible, we advise you upon opening of your drum of **MethaPlus®** to keep the entry risk of microorganisms on the **MethaPlus®** drum as low as possible.
- 2) Enzyme stability of the product: the product needs to be shielded for external factors like pH changes and elevated temperatures that negatively influence the functionality. Storing enzymes cool (< 20°C) in an area protected from direct sunlight or other heat sources, will help to extend the stability of enzymes and **MethaPlus®** specifically.

Can I use the enzyme even after many years in stock?

Yes, when stored properly in an unopened container, the enzyme activity will decay 1% per month, so you can extrapolate how much activity (functionality) has been lost. At DSM we measure our stock regularly against our quality control criteria.

How to reduce enzyme costs?

Enzymes dosage (cost) depends highly on (the stability of) your own operations. Every change in the enzyme environment will have an effect (positive or negative) on the performance of the enzyme. Enzyme dose (costs = €) can be extremely low if you have the ideal enzyme conditions AND a lot of time. Allow us to support you in optimization of your cost effectiveness ratio.

What is a concentrated enzyme?

Enzyme products that are very rich in effective protein are called concentrates. These concentrates are theoretically attractive since you require small amounts of enzyme product for your process and less logistic volume and less storage capacity requirements. There are, however, serious drawbacks on concentrated enzymes:

- a) Even distribution of your enzyme over your substrate becomes more difficult
- b) Small drops can get lost
- c) Spillage will be costly (see below).

These drawbacks of concentrates will take you far away from your effective dose. At DSM we collected a wealth of experience to optimize ease of handling and concentration of effective enzyme molecules.

Our **MethaPlus®** formulation has been chosen such that it offers a perfect balance between a reasonable dosing quantity and effectiveness.

Spillage of effectiveness when using concentrated enzymes?

Concentrated enzymes make even distribution over your substrate difficult, which means that you will lose efficacy. Tests have proven that at least 0,5% of the required enzyme dosing remains in your enzyme dosing system (bucket or beaker). Often it is even > 1%, especially when the beaker is not rinsed with water after every use. This is not only a loss of product but also a loss in efficacy in your reactor and, maybe more importantly, a loss of money. The more active the product, the less you have to add, and the more stays behind in your dosing tools, meaning the more money you lose. DSM is driving towards more diluted products in order to reduce these risks. We balance this with packaging, shipping and storage costs.

What is the price for an enzyme?

Enzyme prices per kg are irrelevant. It is more relevant to consider the cost in use: the enzyme quantity required to reach the desired effect in the available amount of time and under the available conditions, multiplied with the price per kg.

How to apply enzymes?

Enzymes can be added into your system in many ways. Liquid enzyme products can be dosed by pumps. These pumps are balanced with the substrate input to your biogas installations on which the enzyme needs to act. Rule of thumb: more substrate requires more enzyme OR more time. Enzymes are preferably distributed evenly over the full substrate mix that needs to be hydrolyzed. Proper distribution will reduce the time required to perform the hydrolysis actions. If the 'natural scissors' need to migrate though the substrate before they can be active, this leads to a loss of time. Therefore sufficient mixing is required. For Dry enzyme application **MethaPlus® S100** please take measures to protect yourself against the inhalation of the powder. See the available safety datasheets for **MethaPlus® L100** or **MethaPlus® S100** accordingly. Allergic reactions could appear. When using dry products which also hold the microbial/fungal biomass then even extra care should be taken to reduce the spread of the fungal spores. Please note that other enzymes offered in the biogas market sometimes contain the total fungal biomass. The risks of fungal spores in such products should not be ignored (specially in powders/ground dry product). Liquid products from which the biomass is removed are preferred. Please use **MethaPlus® L100** as your enzyme for the hydrolysis of fibers in your biogas raw material.

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