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WHITE PAPER

Odours from dewatered sludge: acting at the source through the polymer

Preventive odour treatment with Enviro-Chem Cx in the sludge line

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In brief

- A significant share of the odours of a dewatered sludge can form after dewatering, in the cake, notably through protein degradation.
- Conventional treatments (iron salts, nitrates, air scrubbing or filtration) each have their own targets and conditions of effectiveness. Controlling sulphide or the extracted air does not guarantee control of the secondary emissions from the cake.
- Enviro-Chem Cx acts upstream: dosed into the polymer solution, it is distributed throughout the whole sludge mass at the moment of flocculation and slows the release of odorous compounds during conveying, storage and handling of the cake.
- Implementation: a dosing pump and a canister at the polymer station. Reference dose: 1 litre per tonne of dry solids.
- Cx slows the formation of both odour families arising from protein degradation: sulphur compounds (H_2S , mercaptans, organic sulphides) and nitrogen compounds (ammonia, amines such as trimethylamine, putrescine and cadaverine, indole and skatole). It can be applied at various stages of the sludge line.

1. Where the odour of a dewatered sludge comes from

A sludge with little odour at the centrifuge outlet can become odorous one to a few days later, in the skip, the silo or the storage shed. This delay may reflect the formation of compounds in the cake after dewatering, without excluding the initial presence of odorous compounds.

This mechanism has been described in detail by a North American research programme conducted on eleven plants equipped with anaerobic digesters (see references). Its conclusions come down to three points:

- **The source is protein.** The main odorous compounds of the cake are volatile sulphur compounds — hydrogen sulphide, methyl mercaptan, dimethyl sulphide and dimethyl disulphide — arising from the biodegradation of the sludge proteins, and in particular of their sulphur-containing amino acids. The same degradation releases nitrogen in the form of ammonia and amines.
- **The trigger is mechanical.** The shear undergone in the centrifuge, the screw conveyors and the cake pumps makes available proteins that were until then protected within the flocs. The bacteria that degrade them grow rapidly, whereas the micro-organisms able to consume the sulphur compounds formed are slowed down by dewatering.

- **The emission follows a curve.** In the eleven cakes studied, the production of volatile sulphur compounds peaks between 3 and 8 days of storage, then declines. Anaerobic digestion therefore does not eliminate all potential for odour formation after dewatering: secondary emissions can still appear in the cake.

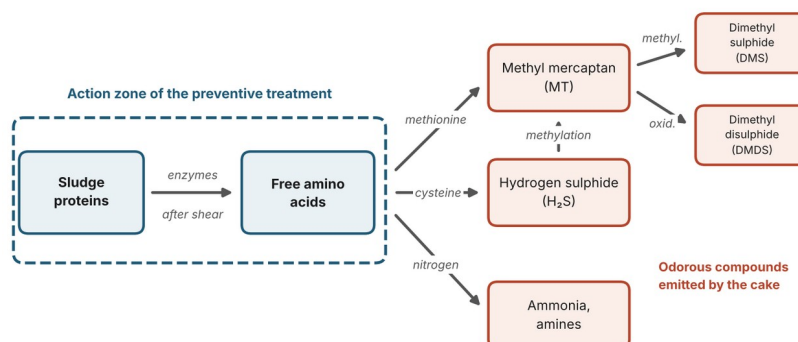


Figure 1 — Formation pathways of odorous compounds in the cake. Diagram redrawn after Higgins et al. (2006, 2008).

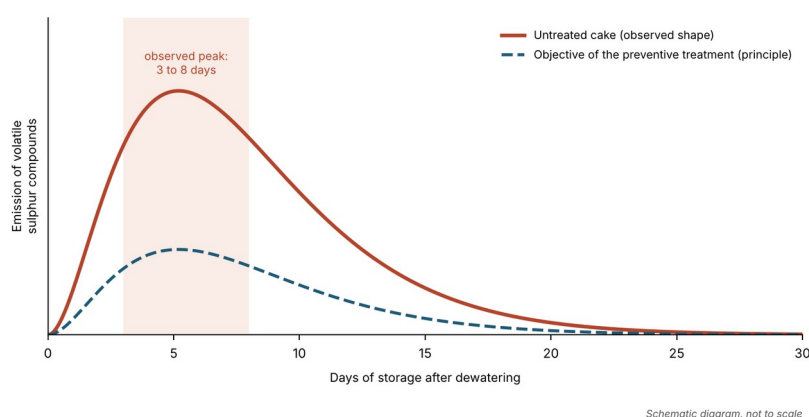


Figure 2 — Shape of the emission during storage. Schematic diagram after Novak et al. (2006); the dashed curve illustrates the objective of the treatment, it is not a measurement.

Two practical consequences. Storage and handling of the cake must be included in the assessment of emissions. Moreover, controlling sulphide in the biogas or the sewer network does not guarantee control of the odorous compounds formed after dewatering: a sludge storage shed can still be a nuisance to the neighbourhood.

2. The principle of Enviro-Chem Cx: prevent rather than capture

Enviro-Chem Cx is an acidic aqueous formulation of organic and mineral active ingredients, fully miscible with water. It is neither a masking agent, nor an oxidant, nor a biocide. The mechanism is preventive: Cx interacts with the accessible protein matter and slows its enzymatic degradation, and therefore the formation of odorous compounds. This is referred to as temporary stabilisation of the biomass.

Temporary, because the organic matter is neither destroyed nor made refractory: the sludge retains its agronomic value and remains compatible with the usual outlets, land application and composting. The aim is to flatten the emission peak of the first days, that is, the period during which the sludge is conveyed, stored, loaded and transported.

The product has been marketed for more than twenty years in municipal and industrial wastewater treatment (breweries, pharmaceuticals, food industry). The same formulation is used in anaerobic digestion (biogas plants) under the name Enviro-Chem METHA.

3. Why the polymer is the right injection point

Any mechanical dewatering — centrifuge, belt filter press, filter press — involves a cationic polymer preparation unit. Adding Cx there combines four advantages that no other point in the sludge line offers together:

1. **The right moment.** The product reaches the sludge just before the shear that releases the proteins.
2. **The right mixing.** The polymer solution is injected in-line and intimately mixed with the whole of the sludge. The product benefits from this distribution, which is impossible to achieve by spraying onto a cake that has already formed.
3. **No heavy equipment.** A small dosing pump and a canister placed next to the polymer preparation unit are enough. Nothing is modified on the line.
4. **A dose that can be calculated.** The dry solids produced are known; the dose follows directly from them.

4. Implementation

Parameter	Recommendation
Injection point	Polymer preparation tank, in a stirred compartment where the polymer is already dissolved (maturation or mixing tank). Failing that, in-line into the polymer solution.
Reference dose	1 litre of Cx per tonne of dewatered dry solids, to be adjusted according to the sludge and the result.
Equipment	Dosing pump set to the average flow rate (continuous preparation) or a fixed volume per batch (batch preparation). Canister or IBC at the foot of the preparation unit.
Compatibility	Cationic polymers (polyacrylamides) are stable in acidic conditions; at the working dose, the product represents only a few hundredths of a percent of the polymer solution.
Safety monitoring	Cake dryness and polymer consumption, monitored as usual. At this dose, we have never observed any effect on dewatering.

Order of magnitude

A plant that produces 20 t/day of cake at 25% dry solids produces 5 tonnes of dry solids per day: the reference dose is 5 litres of Cx per day, i.e. one 1,000-litre IBC for more than six months. If the polymer is dosed at 8 kg per tonne of DS in a 0.3% solution, these 5 litres are diluted in more than 13 m³ of solution: less than 0.04%.

5. Applications in the sludge line and odour families targeted

Across the whole sludge line

The dewatering polymer is the most practical entry point. Other application points complement it depending on the treatment line.

Stage	Nuisance	Application of Cx
Thickening, liquid sludge tanks and storage	Odours on opening, mixing and tanker unloading	Dosing into the sludge, at the inlet of the structure or on the recirculation
Anaerobic digestion	H ₂ S in the biogas, wear of the activated carbon	Dosing into the digester feed (same formulation, under the name Enviro-Chem METHA)
Dewatering	Odours in the dewatering building, from the screw conveyors and the skips	Dosing into the polymer (chapters 3 and 4)
Cake storage: skip, silo, shed	Neighbourhood complaints, especially during handling and loading	The sludge arrives already treated via the polymer; additional spraying possible during handling
Transport, composting, land application	Odours off site, where no equipment can follow	The sludge leaves the plant already treated
Solar drying in greenhouses	Odour releases towards the neighbourhood	Upstream treatment via the polymer: the sludge enters the greenhouse already treated
Industrial sludge	Highly fermentable sludge: breweries, food industry, pharmaceuticals	Same application points as on a municipal plant

For a plant with several odorous points, we define the priority applications together with the operator. Upstream treatment complements the existing means.

On the different odour families

The odour of a sludge can combine sulphur and nitrogen compounds, in variable proportions. Conventional treatments have different targets: iron salts target sulphide, and acid scrubbing targets ammonia and amines. For activated carbon, effectiveness depends on the media: impregnated carbons can treat NH₃ and amines. The choice and combination of treatments depend on the compounds present. Cx targets, upstream, the fraction arising from protein degradation.

Odour family	Origin in the sludge	Conventional treatment	With Cx
Hydrogen sulphide (rotten egg)	Sulphur-containing amino acids	Iron salts, caustic soda and bleach scrubbing	–99.9% (Certech test)
Mercaptans (rotten cabbage)	Methionine	Oxidising scrubbing, activated carbon	–88% (Certech test)
Organic sulphides, DMS and DMDS (cabbage, garlic)	Mercaptan derivatives	Activated carbon	–64% and –26% (Certech test)
Ammonia and amines (pungent, fishy)	Protein nitrogen	Acid scrubbing, biofilter, suitable impregnated carbon	Same upstream action: Cx slows the protein degradation that releases ammonia and amines.

The Certech figures are those of the laboratory test detailed in chapter 7. Sulphide of mineral origin (sulphate reduction) is not covered: see chapter 9.

6. Illustration: a wastewater treatment plant in Italy

A wastewater treatment plant in Italy has implemented Enviro-Chem Cx by adding it to the dewatering polymer. The photos below show the installation as carried out on site by our Italian distributor.



Photo 1 — Polymer preparation unit. The dosing pump and the product canister are simply placed at the foot of the unit, next to the control cabinet.



Photo 2 — Injection point: a thin tube attached to the existing pipe delivers the product directly into the polymer solution, inside the tank.



Photo 3 — Dewatering building: decanter centrifuges and cake discharge by screw conveyor. The product arrives here with the polymer, without any modification of the line.

7. Supporting evidence

- **Independent literature.** The protein origin of cake odours, the role of shear and the shape of the emission curve are established by published work unrelated to the product (references below). They justify the choice of injection point and of target.
- **Independent laboratory tests.** A comparative test on treatment plant sludge, with a control, was carried out by the research centre Certech (Belgium); its results are detailed below. Certech also verified the absence of biological inhibition at the working dose.
- **Field experience.** More than twenty years of use in wastewater treatment, at several plants across Europe, for the treatment of plant odours and of sludge; the oldest reference, the Córdoba plant (Spain), has used the product continuously since 2003. In anaerobic digestion, the same formulation reduces H₂S in the biogas at some thirty sites.

The Certech comparative test (2013)

Certech, a laboratory accredited by the Walloon Region for odour measurements, compared a treated drum and a control drum: 6-litre drums loaded with 2 litres of liquid sludge and 500 g of solid sludge from the same sample, with headspace vapours sampled through a septum and analysed by gas chromatography (GC-FPD) at eleven time points over 360 hours.

Compound	Control	Treated	Difference
H ₂ S — free sulphide	930.6 ppm	0.3 ppm	–99.9%
Methyl mercaptan — free thiol	147.6 ppm	17.8 ppm	–88%
Dimethyl sulphide — thioether	242.0 ppm	87.6 ppm	–64%
Dimethyl disulphide	14.6 ppm	10.8 ppm	–26%

Values at the maximum of the control, compared with the treated sample at the same time. Source: Certech report 13/521, available in full on request.

The test is conducted in a closed reactor, at a laboratory concentration higher than operating doses. It shows that Cx limits the formation of sulphur compounds at the source.

8. On-site evaluation

An on-site trial lets you see the result under your own conditions. We define it together with the operator; for a solar drying greenhouse, the schedule below is adapted to the residence time and the operating conditions:

1. **Baseline — 1 week (indicative).** Measurements without product at the selected points; record the sludge characteristics, temperature, ventilation and turning or loading operations.
2. **Dosing — 4 weeks (indicative).** Cx in the polymer, with 1 L/t DS as a starting point to be adjusted; monitor emissions, dryness and polymer consumption under comparable conditions.
3. **Stop — 2 weeks (indicative).** Observe the evolution after returning to untreated sludge, taking into account the renewal of the sludge in the greenhouse and variations in weather and operation.

Monitoring covers the odorous compounds present on site: H₂S, but also NH₃, amines and organic sulphur compounds, with measurements suited to each. Observations by staff and local residents complement this monitoring.

To prepare the trial, specify the tonnage and dryness of the sludge, its origin and whether it is digested, the polymer consumption and preparation, as well as the residence time, ventilation and turning in the greenhouse.

9. Scope of action

Cx prevents the biological formation of odorous compounds arising from protein degradation: sulphur compounds, ammonia and amines. It acts in the sludge, not in the air: it does not capture compounds already present, and sulphide arising from sulphate reduction is not its target. The earlier it is applied, the more odour there is to prevent.

In solar drying, Cx acts on the odours that form in the sludge; ventilation and air treatment handle the compounds already volatilised.

References

- Higgins M.J. et al. (2006). Cycling of volatile organic sulfur compounds in anaerobically digested biosolids and its implications for odors. *Water Environment Research*, 78(3), 243-252.
- Novak J.T. et al. (2006). Generation pattern of sulfur containing gases from anaerobically digested sludge cakes. *Water Environment Research*, 78.
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