CONCLUSIONS OF THE QUICKSCAN UNDER THE EU ETV METHODOLOGY

Technology: **Technology for Catalytic Detoxification of Persistent Organic Pollutants**

Aplicant:
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Verification body:
CEMC ETVCZ
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DESCRIPTION OF ACTIVITIES, RECOMMENDATIONS: Inspection body no. 4055 carried out an analysis of the document Quickscan (part A), based on the results of the POPDESTR project "Technology for catalytic destruction of persistent organic pollutants" (program INTER-EUREKA, LTE117016, Provider of the Ministry of Education .D., Duration 2017-2019).

Assessment of the submitted information found, among other things, that the results achieved, thanks to the unique method of CDC (Catalic Destruction using Cooper), demonstrate unrivaled parameters of detoxification of dangerous substances (POPs and others). Given the great potential for addressing environmental issues, **we recommend carrying out the so-called full EU ETV verification process in order to include this technology in the European database of proven technologies.**

The inspection body's opinion is based on the EU ETV methodology (ver. 1.3), based on the documented opinion of two independent experts (see part B and 2x expert opinion in the appendix).

Verification body:	CEMC ETVCZ (Inspection body no. 4055)
Name and surname: Ing. Jiří Student Date: 31.1.2020 Podpis:	CEMC ETVCZ inspekční orgán akreditovaný ČIA č. 4055 28. pluku 524/25, 101 00 Praha 10 tel.: 274 784 416-17 www.cemc.cz

Appendix 3: Template for the Quick Scan

This template may be modified by the ETV Technical Working Groups and published as a guidance document, without need to update the General Verification Protocol.

EU Environmental Technology Verification

Quick-Scan

Purpose: *This form aims to collect sufficient information about the proposed technology in order to evaluate eligibility under the EU ETV Programme and to provide early indication of the potential costs involved. The proposer completes the Quick scan for assessment by the Verification Body. The boxes for responses, in grey, may be extended but responses should remain brief and no more than one half-page each..*

Verification Body		Proposer	
Name:	CEMC ETVCZ	Name:	E&H services, Inc.
Contact person:	Ing.Jiří Student, st.	Contact person:	Ing. Tomáš Ocelka, Ph.D. Ing. Jiří Oceánský
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Quick-Scan date:

Previous Quick Scan performed: ☒ No ☐ Yes, date:

Indicate if you have already submitted a quick-scan on the same or similar technology to be evaluated by this Verification Body

Identification of the Technology

Name of the Technology: Technology for Catalytic Detoxification of Persistent Organic Pollutants

NB : A technology can be a product, a process or a service

Technology Area:

☐ Water Treatment and Monitoring

☒ Materials, Waste and Resources

☐ Energy Technologies

☐ Other:

If the technology could fit in more than one area, please signal this and insert a clarification in the comment section.

Comments: This technology is able to destroy - decontaminate persistent organic pollutants (POPs), highly stable substances resistant to chemical and biological degradation. These substances are dangerous for the environment and human health. Under the Stockholm Convention of 2001, the signatory states undertook to systematically limit the production and use of POPs. Our technology provides a solution to this problem by catalytic destruction and the conversion of these substances into completely safe materials.

Briefly explain the specific problem(s) or opportunities your technology wishes to address

General description of the Technology

This is a technology for dehalogenation (detoxification) of solid waste containing highly chlorinated persistent organic pollutants (POPs) based on the Catalytic Destruction using Copper (CDC) method. The detoxification of various materials in our reactor is primarily be oriented on thermal process products containing POPs, with the main focus on contaminated fly ash and other toxic waste from municipal, hospital and hazardous waste incineration plants. This technology is also suitable for other contaminated materials with both polar and non-polar substances.

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Tests were carried out on various input materials with different matrix and level of contamination to optimize the technology. The proposer has the long-term experience of this technology management and there are increasing requirements for this application for new input materials. The proposer has a laboratory's analytical background operating in ISO 17025 mode, enabling efficient optimization of the technology.

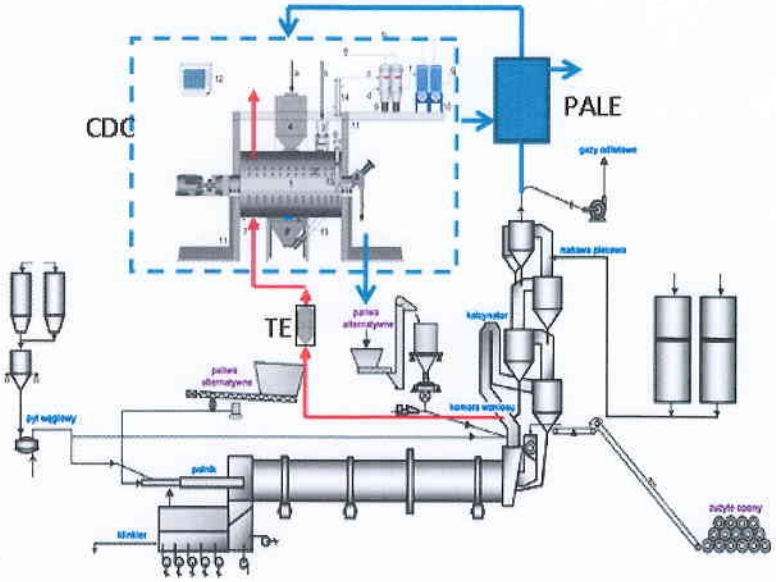

Fig.1: CDC technology scheme for industrial use

Fig. 2: CDC mobile technology in technologic hall in Radvanice

Examples of application parameters:

- The reactor is a pressure vessel with stirring, carrier gas supply, off-gas cooling, fraction divider (reflux) and electric heating,
- Heating gradient: approx. 300 °C/45 minutes,
- Temperature profile of controlled reactions: 150-300 °C,
- The reaction components are: copper catalyst and hydrogen donor,
- Reaction time: 4 to 6 hours,
- Cooling: loose,
- Reactor volume 1-5 m^3
- Size of each charge: approx. 250 kg,
- Analytical determination of destruction efficiency,
- Possibility to use waste heat from metallurgical plants.

How does this technology address the problems or opportunities?

Main purpose of the technology:

The advantages of CDC method are simplicity, versatility, cost-effectiveness and high technological efficiency for POP degradation. The technology is mobile, we can transport technology instead of transport of contaminated material, which in many cases is not even possible (mainly due to national legislative restrictions). Technology based on the CDC method was initially developed for use in detoxification of incineration ash (WTE). Currently there are about 500 WTE incinerators worldwide. However, their potential is much wider: old environmental burdens, water purification (capture to a suitable sorbent), sediments - highly contaminated with pesticides and polychlorinated biphenyls, recycling of sorbents that are characterized by high dioxin content and its precursors, and solving the elimination of dust residues in agglomerations.

Our solution offers a approach where residues from thermal processes can be directly irreversibly detoxified and thus prevent further exposure to the environment and human health by toxic substances. Adding to the technology is our complex of analytical methods that will contribute to the optimal use of remediation technologies.

Relevant alternatives

The 'relevant alternative' helps to determine the environmental added-value and innovation level through a qualitative comparison (quantitative if data is available). It should perform an identical or similar function as the technology under verification but it can correspond to different technologies working in sequence, e.g. in recycling, a material sorting procedure including dismantling can be an alternative to a crusher. It should be a current technology that is commercially available, it should be legal and accepted by end-users in the specific targeted market(s), It should also be effective in achieving a reasonably high level of protection of the environment.

Relevant alternatives on the market:

- BCD (Base Catalyzed Decomposition),
- GPCR (Gas-Phase Chemical Reduction).

Principles of alternative technologies

BCD - Base Catalyzed Decomposition

The BCD waste treatment process ensures the chemical decomposition of chlorinated hydrocarbons. Contaminated waste and reaction chemicals (sodium hydroxide and catalyst) are separately mixed with the added oil (donor) and stirring in the disolver (mixing tank) produces a pumpable mixture for dosing into process reactors. The chlorine conversion takes place on the aromatic nucleus behind the hydroxyl group. Possible basic risks: chlorinated phenols easily polymerize to substances of unknown toxicity, creation of lower chlorinated PCDD/F is not excluded, dechlorination efficiency decreases significantly with increasing phenol formation.

GPCR - Gas-Phase Chemical Reduction

The gas phase chemical reduction process is two-phase. Depending on the type of waste, a suitable method of material pre-treatment is selected. During the first phase, organic pollutants are desorbed from the contaminated soil at a temperature of 600°C. The vapors of the evaporated organic solvents are fed to the GCPR reactor. They are destroyed during the second phase by reduction with hydrogen at a temperature above 850°C. Chlorinated organic compounds are reduced to methane, hydrogen chloride gas and smaller amounts of low molecular weight hydrocarbons. Decontamination of arsenic and mercury wastes generates elemental metals in the gas phase, which is a problem in the purification and evacuation of gases into the atmosphere. The large volumes of hydrogen gas required for the decontamination reaction also pose a potential hazard.

Advantages / disadvantages of alternative methods

Aspect	CDC	BCD	GPCR
Destruction efficiency	High for a wide range of substances	Dependent on the type of substances (degree of chlorination)	Dependent on the degree of chlorination
Residual toxicity	No	Possible formation of polycondensated substances	Depends on the matrix
Aggressive media	No	Yes	No
Maximum Operating Temperature	Approx. 300 °C	Up to 400 °C	Over 850 °C
In-situ layout	Yes	Limited mobile layout	
Material capacity	Suitable for small and medium volumes, for very high volumes time consuming	Suitable for large volumes	

Principle used:

The principle of the catalytic reaction is based on a reaction mechanism that is independent of the degree of halogenation and the position of the halogen. It is not a combustion technology.

The mechanism is based on the reaction of a halogenated substance (aromatic or linear skeleton), which is catalysed by copper:

$ArX + 2Cu \rightarrow [ArCu] + CuX$

Which are the scientific or technical principles and techniques used by this technology

wherein Ar is a halogen anion and X is a hydrocarbon skeleton.

Dehalogenization occurs:

$[ArCl\ 3] + H^{+} \rightarrow ArH + Cu^{+}$

and to the Ullman reaction (biaryl formation) to form non-toxic and further useful substances:

$2\ [ArCu] \rightarrow Ar\text{-}Ar + 2Cu^{0}$

$[ArCu] + ArX \rightarrow Ar\text{-}Ar + CuX.$

Which are the main claim(s) on the technology's performance that would need to be verified? (Preliminary elements for the performance claim)

Consider as much as possible verifiable, quantifiable features, expressed in absolute (i.e. not comparative) terms. Please note that the initial performance claim is starting point for the verification and may evolve during the verification process

Input toxic concentration: 1-100 µg I-TEQ / t total chlorine destruction efficiency DE> 99.9%, at 250 kg / 6 hr capacity for CDC unit in aplication for metallurgical ash collecting on baghouse filters and electrofilter capture - final deposit after wet flue gas combustion products

Under which conditions is this performance(s) achieved?

Detail the key operational parameters and limits in order for the technology to perform as described in the claim.

- High initial concentrations of toxic substances: 1-100 µg I-TEQ/t
- Pressure: atmospheric
- Temperature: 290-300 °C (De novo thermodynamic window)
- Environment: inert (non-oxidizing) atmosphere (inert gas, e.g. nitrogen)
- Mode: discontinuous or semi-continuous by cycling the operation of individual units
- Time: 4-6 hours

Main technical standards, regulations or references applicable to this technology:

Are there existing standards that cover (parts of) this technology? What are the main regulations relevant for this technology? Are you aware of any guidelines that would be useful for the verification of this technology?

- Technical guidelines General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants, General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutantsUNEP/CHW.13/6/Add.1
- Limity pro PCDD/F v různých složkách životního prostředí https://arnika.org/dioxiny-pcdd-pcdf
- Ocelka, T. 2017. Characterisation and perspectives of novel method for dehalogenation of POPs: Chemical Destruction using Copper (CDC)
- Ocelka, T., S. Nikl, R. Kurkova and L. Pavliska 2011. Application of Copper Mediated Destruction technology for trial dehalogenation of pesticides concentrates in Jaworzno dump site in mobile full scale unit. 11th HCH and Pesticides Forum. Baku, Azerbaijan. Session 13: POPs management and destruction.
- Ocelka, T., V. Pekárek, E. Fišerová, M. Abbrent, J. Kohutová, J. Hetflejš and M. Lojkásek 2010. "Copper mediated destruction (CMD) – a novel BAT technology for POPs destruction" Organohalog Compd 72: 1258-1259.
- Pekarek V., Ocelka T., Grabic R., Bureš M.: The Application of Copper Mediated Destruction Method (CMD) for Destruction of Clorinated Pesticides and some Pre-dioxin and POP Compounds, 8th International HCH and Pesticides Forum, 26-28 May 2005, Sofia, Bulgaria
- Ishida M1, Shiji R, Nie P, Nakamura N, Sakai S.-Full-scale plant study on low temperature thermal dechlorination of PCDDs/PCDFs in fly ash, Chemosphere. 1998 Oct-Nov;37(9-12):2299-308.

Market readiness

Is the technology already on the market?

☒ No ☐ Yes, number years:

A verification will check whether the technology matches the claimed performance. Ideally this verification should only be done once the product is finished, so as to reduce costs of new verifications with changes or upgrades to the technology.

If no, is there a prototype or a demonstration unit available?

☐ No ☒ Yes ☐ Pilot scale ☒ Full-scale

When transforming the prototype/ demonstration unit into a marketable product, will any changes affect the technology's performance?

The intention is to determine if the technology is ready to market: "is it available on the market or at least available at a stage where no substantial change affecting its performance will be implemented before introducing the technology on the market (e.g. full-scale or pilot scale with direct and clear scale-up instructions)".

☒ No reason: The demonstration unit is in a fully convertible into a market product without any changes.

☐ Yes How substantial will the changes be?

The parameters will be optimized depending on the properties of the particular type of material, its amount and contamination rate and operating parameters, including catalyst concentration. Our company has sufficient equipment, including laboratory facilities, to achieve the required efficiency and capacity.

Innovation level

Description of the innovation provided by the technology, in comparison with relevant alternatives on the market:

Novelty presented by the technology in terms of design, raw materials involved, energy used, production process, use, recyclability or final disposal, when compared with the alternatives identified above

Similar technology with sufficient efficiency in the mobile configuration is not yet available on the market. Our technology has been used in previous generations in remediation work in the contaminated area of Jaworzno (Poland) with excellent results.

Advantages over potential competitive technologies:
- High destructive efficiency
- Possibility of mobile deployment (in-situ), small field area coverage
- Wide range of contaminants - destruction does not depend on the degree of chlorination
- Disposal of precursors
- Non-incineration method - no leaks to air
- Does not require aggressive media
- Simplicity - reaction mechanism well described, possibility to optimize the method
- Ability to control all process material flows.
- Ability to reprocess materials when the process needs to be repeated to achieve the maximum possible DE efficiency
- Reliability - for a wide range of concentrations from trace amounts to contaminant concentrates

Environmental added-value

Please provide a short overview of the major positive and negative environmental aspects of your technology in each of the four main life-cycle stages identified below:

You are expected to provide as much information as possible, especially for the manufacturing and use phases. Qualitative or quantitative information may be given on emissions, waste streams, consumption or use of raw materials, energy and water. The information provided will help the Verification Body assess whether your technology would fit and benefit from an ETV. If you have no detailed information you are encouraged to provide any generic information you may have useful to the evaluation.

In some cases you may limit the amount of information, in particular when:
i) the technology will lead to environmental pressures/impacts that are not significantly different than those of the relevant alternative
ii) those environmental pressures/impacts are negligible compared to those of the other phases
iii) the information cannot be obtained – please provide a short justification in this case

Natural resources (raw materials, energy) extraction and transformation phase:

Is this stage under your direct control? ☐ Yes ☒ No

Do you have information concerning environmental aspects for this stage? ☐ Yes ☒ No ☐ Partial

Extraction, refining, processing, transformation and transport of natural resources including every aspect of all activities involved before the manufacture of the technology's equipment, sub-assemblies or products. By definition, this also includes all of the raw materials, the energy and water used and all waste or emissions released to the environment during these activities.

In terms of environmental impacts or environmental added value, are there significant differences in this stage between your technology and relevant alternatives?

☐ Yes ☒ No

Major positive and negative environmental aspects: This technology is directly designed to protect the environment and humans from harmful pollutants - persistent organic pollutants.

Manufacturing phase:

Manufacturing of parts, components, machinery and of products including every aspect of the production of the technology. In general, it is expected that this will include the production of most if not all sub-assemblies. This also includes all of the water, energy and consumables used, together with all of the emissions and all of the products and wastes. This will generally occur on production sites under control of the proposer.

Is this stage under your direct control? ☐ Yes ☒ No

Do you have information concerning environmental aspects for this stage?
☐ Yes ☒ No ☐ Partial

In terms of environmental impacts or environmental added value, are there significant differences in this stage between your technology and relevant alternatives?

☐ Yes ☒ No

Major positive and negative environmental aspects:

The technology is located in the technological hall of our company in Ostrava-Radvanice in mobile containers and ready for use. The production phase of our technology does not have a significant impact on the environment.

Use phase:

Use and maintenance phase of a product, a process or a service including estimates of its use by the client/end-user refers to consumables, maintenance, and all raw materials, energy and water used for its functioning, as well as all the emissions, products and waste streams.

Is this stage under your direct control? ☒ Yes ☐ No

Do you have information concerning environmental aspects for this stage?
☒ Yes ☐ No ☐ Partial

In terms of environmental impacts or environmental added value, are there significant differences in this stage between your technology and relevant alternatives?

☒ Yes ☐ No

Major positive and negative environmental aspects:

The decontaminated fly ash can be used immediately after mixing with the underneath ash and stabilization. For example for reclamation, as a material for transport infrastructure (road) or for the building materials production.

End of life phase:

Is this stage under your direct control? ☒ Yes ☐ No

Do you have information concerning environmental aspects for this stage?
☒ Yes ☐ No ☐ Partial

End of life of a technology including every aspect of all activities involved in the 'End of Life' of a product or an equipment, when it is discarded by the client/end-user, including its recycling, dismantling and/or disposal of all components. This also includes all of the water, energy and consumables used, together with all types of emissions, all of the products and wastes.

In terms of environmental impacts or environmental added value, are there significant differences in this stage between your technology and relevant alternatives?

☒ Yes ☐ No

Major positive and negative environmental aspects:

There will be no longer toxic substances at this stage. Disposal will be carried out in the usual way for the processing of metals and other used materials. There are no hazardous materials/wastes left, in contrast with combustion and other technologies where high-volume additional reactants are used. In addition, our company has all the necessary resources, including the analytical background to evaluate contamination.

Potential to meet user needs

Does the technology have the potential to meet user needs?

☒ Yes ☐ No

Does this technology address a need in the market? Are the advantages provided a real advantage to the user? If the technology is already on the market provide general information on its success in addressing user needs.

What specific user needs is the technology addressing? How does this technology meet the user needs?

The proposer intends to take advantage of the absence of similar technology not only in the Czech Republic but also abroad (Europe, USA) to decontaminate POPs and contribute to solving the problem of polluted environment (air, watercourses and dumps), which is contaminated with the above mentioned harmful organic substances.

An example of the application of the technology is the decontamination of soil pollution of sediments in the Elbe region. This contamination of OCP, PCB and PCDD/F is considered to be one of the main priorities of the International Commission for the Protection of the Elbe (ICPD). In the case of industrial wastes, solid materials have so far been deposited in landfills for hazardous waste - and this practice is still ongoing, although there is considerable environmental impact. It is the place for the technology similar to that proposed in this project. In addition, high PCDD/F limits in fly ash have been admitted due to the absence of similar technology to allow their detoxification at the location of origin.

Fulfilment of legal requirements

What is the target market for this technology?

☒ EU ☒ Specific country/countries: Moravian-Silesian region

☒ Other: USA, worldwide

Does the technology fulfil the legal requirements in the targeted market(s)?

☒ Yes ☐ No

Comments:

There is a global consciousness that this issue needs to be solve for a wide range of materials, including at the legislative level. We are not aware of any limitation of our technology, which would be regulated by legislation, not for input materials nor for production processes. When the technology release to operation, the relevant laws, such as the Air Low, the Water Low, the Waste Low, and hygiene limits for the working environment will be fulfil.

Intellectual Property Rights (IPR)

Are you the sole and full owner of the technology? ☒ Yes ☐ No

If no, do you detain intellectual property or other rights on the technology?

☐ Yes ☐ No

Description of the license or other contractual arrangement giving you the legal right to ask for the technology to be subject to a verification procedure:

CDC technologie - patent EU číslo PCT/CZ2004/000024, subject of Czech patent is application in metallurgy: Pekárek V., Hapala P., Fišerová E.: Process for Dehalogenative Detoxification of Halogen Aromatic and/or Cyclic Compounds. EU Patent application No.PCT/CZ2004/000024

Are there any Intellectual Property issues in respect of this technology or any part or aspect of the technology that might prevent its development and/or which could result in any legal or other issues for the ETV Programme?

☐ Yes ☒ No

Comments:

☒ Please tick here to authorize the Verification Body to share the information provided in the Quick Scan in a confidential way with the ETV Technical Working Groups.

The purpose of information sharing is harmonization and improvement of the EU-ETV programme. All members of the Technical Working Groups have the same confidentiality obligations as the Verification Body.

Please note that, once a verification contract is concluded, the main process documents including the Quick Scan, specific verification protocol and verification report, will be shared with the ETV Technical Working Groups in a confidential way.

Existing data

Are there available test results or other data to back-up the technology's performance?

☒ Yes ☐ No

Please include in your comments, if a test plan was followed, if standard methods were used, if testing was done by accredited testing bodies, i.e. ISO 17025

Comments:

In the attachment we send the documents as examples of the tests were carried out in previous years:
- PCDD/F Pilot Destruction Tests in Metallurgy Air ash, April 2017
- FOKS project - Copper mediated destruction (CMD) transfer of novel POPs technology from lab to full-scale unit - From POPs dehalogenation results to ETV certification
- Project FOKS - Project Progress Report
- Measurement protocols, including certificates of sampling persons.

If test results are not available, please indicate if you have a test plan prepared and/or if there are test methods available, including standard methods.

Assessment of Quick-scan (for the Verification Body)

Assessment of the technology description

The technology fits in the scope of the EU ETV programme? ☒ Yes ☐ No

Comments: The technology for Catalytic Detoxification of Persistent Organic Pollutants is suitable for detoxification of a wide range of products from thermal processes containing POPs (mainly for contaminated fly ash) and as well as other toxic wastes from municipal, hospital and hazardous waste incinerators.

Compared to competing approaches, it is the most advantageous technology. It contributes to the fulfillment of the 2001 Stockholm Convention in reducing POPs.

Conformity of the opponents.

Description/principles clear? ☒ Yes ☐ No

Comments: Technology is based on the Catalytic Destruction using Copper (CDC). Technology is sufficiently described in this document by the technological and process diagram of CDC technology incl. principle of chemical reactions, which describe the principle of destruction of chemicals in the reactor and operating parameters.

Conformity of the opponents.

Clear and verifiable performance claim(s)? ☒ Yes ☐ No

Comments: The proposed performance statement is sufficiently specific and verifiable. It is based on the chlorine removal efficiency parameter (DE (Destruction efficiency)> 99.9%), the amount of waste in the feed, their residence time in the reactor and the type of waste treated.

Conformity of the opponents.

Ready-to-market? ☒ Yes ☐ No

Comments: The technology is in the phase of the market product, it is in fact already ready for launch on the Czech market. It has already been successfully verified in practical application in Poland and it is not expected that major changes will be made to the design of the equipment, i.e. those that would affect the performance parameters.

Conformity of the opponents.

Prototype in advanced stage of development? ☒ Yes ☐ No

Comments: phase of the demonstration unit has already been overcome, see. previous comment.

Technology shows innovative characteristics? ☒ Yes ☐ No

Comments: In the chapter Innovation level a wide list of the advantages of CDC technology over competing approaches is given. It is designed as a mobile unit that can be used at the contamination site. It has a huge advantage over other possible non-combustion methods at a relatively low process temperature (300 ° C). For medium and small quantities of material, CDC is an unbeatable solution. In addition, it can use an external heat source to improve its energy balance.

Conformity of the opponents.

Potential to meet user needs? ☒ Yes ☐ No

Comments: The potential of the technology is based on innovative parameters. It allows the removal of contamination of a wide range of contaminants occurring in the input and output components in various phase forms with high efficiency (up to 99.9%).

The technology offers wide applicability in general in the field of waste in various technological processes: metallurgy, incinerators and power generation operations, rubber industry, production of organic substances (i.e. herbicides), waste water treatment plants and so.

Conformity of the opponents.

Fulfilling legal requirements (limited to VB's expertise)? ☒ Yes ☐ No

Comments: In particular, the CDC technology meets the limits of hazardous substances at the outlet. In practical implementation, when commissioning, the relevant laws, such as the Air Act, the Water Act, the Waste Act, the hygienic limits for the working environment, etc. will be applied. The opponents are not aware of any obstacles that might arise in this respect or which should be taken into account.

Conformity of the opponents.

Technology shows environmental benefits? ☒ Yes ☐ No

Comments: This technology is directly designed to protect the environment and people from unwanted pollutants. The advantage of the whole technology is a closed cycle, which also prevents the release of dangerous substances into the environment.

Conformity of the opponents.

Life-cycle aspects described? ☒ Yes ☐ No

Comments: The life cycle is described and no negative effects of technology are detected.

Conformity of the opponents.

Test results are available? ☒ Yes ☐ No

Comments: In the chapter Existing Data is an overview of the projects in which the tests and protocols from measurements were performed, including certificates of subscribers. In individual experimental processes it is possible to trace parameters of destruction efficiency of substances incl. operating parameters.

Conformity of the opponents.

Further testing would/could be necessary? ☒ Yes ☐ No

Comments: The tests were carried out in the applicant's laboratories, so they will have to be repeated in an independent test body.

Conclusions of quick scan by the Verification Body

Enough information is provided to conclude? ☒ Yes ☐ No

If no, indicate the information that needs to be provided:

If yes, is the technology recommended for ETV? ☒ Yes ☐ No

Why? The technology solves the fundamental problem of reducing a wide range of hazardous substances in the environment with a high degree of efficiency and low energy and economic cost. It is a top solution in its non-combustion process category.

Conformity of the opponents.

Technology in the scope of VB? ☒ Yes ☐ No

Comments / remarks / recommendations:

Inspection body no. 4055 CEMC ETVCZ is accredited for the technology area Materials, Waste and Resources, as well as for the area Water purification and monitoring.

Estimated cost range for a verification (excluding tests): 300 000,- Kč

Proposer: E&H Services, Inc.
Name: Ing. Tomáš Ocelka, Ph.D.

Date: 31.1.2020
Signature:

E&H Services, Inc.
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Verification body: i.o. 4055 CEMC ETVCZ
Name: Ing. Jiří Student

Date: 31.1.2020
Signature:

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Opponents:

- Doc. Ing. Vladimír Kočí, Ph.D. MBA., the dean of the Faculty of Environmental Protection Technology, University of Chemical Technology (VŠCHT Praha),
- Ing. Milan Jakubek, Ph.D., VSČHT Praha,

  Specialization: chemical technology and engineering - processes, analytical chemistry, physical chemistry, bio processes. I internal auditor of QA / QC processes and quality management.

EXPERTISE:

A) GENERAL INFORMATION:

APLICANT:

Technology:	**Technology for Catalytic Detoxification of Persistent Organic Pollutants**
Name:	E&H Services, Inc.
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ZIP, city:	140 00 Praha 4, Krč.
ID:	24718602
VAT:	CZ24718602

Opponent:

Name and surname:	Doc. Ing. Vladimír Kočí, Ph.D. MBA.
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Verification Body:

Name:	CEMC ETVCZ
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Purpose of the review:

The purpose of the review is to assess the technology of "Catalytic Detoxification Technology for Persistent Organic Pollutants" by E&H Services, Inc. within the framework of the Quick Verification of Order No. 500 21, implemented in accordance with the General Verification Protocol (GVP 1.3) under the EU Pilot Program for Environmental Technology Verification (EU ETV).

B) REVIEW:

1.1) Description/principles clear?: ☒ YES ☐ No

Comment:

The technology is described in chapter A.3.1 sufficiently. The attached CDC POPDESTR Report is described in detail, including the essence of the technical solution in a mobile configuration. The purpose of POP removal in various areas of the environment is currently highly desirable to solve, this technology has all the prerequisites. The technical principle is clearly described in detail in the Annex (CDC POPDESTR in chapters A4 to A6). In the widespread application of this method to the diverse contamination of organic matter, I see the great potential of this method with a clear positive environmental impact.

1.2) Clear and verifiable performance claim(s)?: ☒ YES ☐ No

Comment:

The performance parameters are defined quite narrowly for use in metallurgy: CDC unit at an initial toxic concentration: 1-100 µg I-TEQ / t ensures a total chlorine removal efficiency of DE (Destruction efficiency)> 99.9%, at a capacity of 250 kg / 6 throw for metallurgical dusts on baghouse filters and electrofilter capture - final deposit after wet flue gas cleaning. High destruction efficiency is one of the main advantages of this technology.

1.3) Technology shows innovative characteristics?: ☒ YES ☐ No

Comment: Technology is certainly innovative, especially in terms of production process, method principle and design simplicity. It has a huge advantage over other possible non-combustion methods at the relatively low temperature used. It is an unrivaled solution for medium and small quantities of material. The draftsman describes in chapter A3.3 two competitive methods, I agree with this comparison, a simple and well described technology is missing on the market, some of the serious disadvantages of alternative technologies have long been known, including the fundamental problem of defining efficacy and generating new toxic substances. From my point of view, there are long-term unsolved old environmental burdens in the Czech Republic and throughout Europe, for which this CDC technology would be the most technically and economically advantageous due to its advantages.

1.4) Potential to meet user needs?: ☒ YES ☐ No

Comment:

In terms of environmental burdens, one of the most up-to-date uses in the metallurgical industry is, as stated by the petitioner, who mentions certain metallurgies that cannot be named (for reasons of preserving commercial interests). Personally, I also see the use in waste incineration plants, where PCDD / F is not satisfactorily addressed across the EU or the world, intensively looking for solutions, while the fly ash material has a similar structure to the tested dusts. Possible application can also affect the rubber industry, producers of organic substances, especially herbicides. Finally, industrial water treatment plants rich in nonpolar (especially halogenated) and polar substances, including pharmaceuticals. Demand certainly exists, it depends only on the courage of operators to use the new innovative method. Waste management seems to me to be crucial and it is an area that many companies in the Czech Republic and the EU are facing.

1.5) Fulfilling legal requirements (limited to VB's expertise)?: ☒ YES ☐ No

Comment: I do not know about legislative requirements that would prevent the use of this technology. BREF - This technology is not combustion and is designed to limit the emission of organic substances into the air. I am not aware of other regulations that should be taken into account.

1.6) Life-cycle aspects described?: ☒ YES ☐ No

Comment: Clearly yes. It is an irreversible process of destruction of chlorinated xenobiotics without the formation of other undesirable toxic substances as well as their emissions into the atmosphere. However, I consider the closed cycle with the process of dry degassing and wet scrubbing to capture possible residues very important.

1.7) Technology shows environmental benefits?: ☒ YES ☐ No

Comment:

Transparently. I see no significant negative impact on the environment.

1.8) Clear and verifiable performance claim(s)?: ☒ YES ☐ No

Comment:

Yes. The destructive efficiency for the removal of chlorine is defined in the relevant Environmental Waste Management Guide cited in Chapter A3.7 and the methods for its measurement are established.

1.9) Ready-to-market?: ☒ YES ☐ No

Comment:

The technology is present in mobile containers in Ostrava and is ready for essentially immediate use both on site and for exit to the contamination site.

1.10) Prototype in advanced stage of development?: ☒ YES ☐ No

Comment:

Functional sample prototype. The petitioner submits in the documents that changes for use in the metallurgical industry will not be made, except for adjustments for optimum use of waste heat (steam) in order to make the operation cheaper. The technology is currently operational. It is practically a market product.

C) ASSESSMENT OF EXISTING TEST RESULTS:

2.1) Tests results are available?: ☒YES ☐ No

Comment:

Testing of technology is also older, having longer time-line data. It can be seen that the proposer performs tests gradually, already in 2012 prepared this ETV verification. The declared efficacy can be seen from the tests. The test parameter is described in detail, including a description of the type of material (dusting). Therefore, the petitioner can declare such a high efficiency. Measurement of the concentration of substances before and after dehalogenation is standard and has no alternative methods.

2.2) Test plan is available?: ☒YES ☐No

Comment:

The tests were carried out in the framework of the POPDESTR project as well as some previous ones, which dealt with the preparation for ETV and therefore contained a test plan. A number of tests - data, are relevant to the purpose of the technology, for given purpose - metallurgical dusts or sorption cartridges having similar matrix effects.

2.3) The test plan is appropriate?: ☒YES ☐No

Comment: Yes. Have no idea how to improve change it.

2.4) Test methods available (standards)?: ☒ YES ☐No

Comment:

The measurement of destructive efficiency is understandable and clear. The proposer operates his own testing laboratory for POP substances with accreditation of test methods according to ISO 17025, so he is able to obtain validated results.

2.5) Test methods are described?: ☒ YES ☐ No

Comment:

The proposer describes test methods according to accredited standard operating procedures.

2.6) Test methods are appropriate?: ☒ YES ☐ No

Comment: Yes, no comments

2.7) The test methods are reproductible?: ☒ YES ☐ No

Comment:

The petitioner performed the tests repeatedly over several years. The results are from the selected metallurgical plant, always with the required match.

2.8) The test methods are accurate?: ☒ YES ☐ No

Comment:

The proposer uses state-of-the-art LC-MS and GC-MS methods with protocol-specific accuracy. The greatest inaccuracy arises when a representative sample is taken from a given batch.

2.9) Test results are available?: ☒ YES ☐ No

Comment:

The proposer enclosed the results of the tests in a protocol form, annexed to the Protocols. The quantity and sufficiency is sufficient if we are limited to the given application and the potential customer of the metallurgical plant, where the contaminated material comes from.

D) CONCLUSION:

Introduced technology is needed for industrial applications. It excels in simplicity and high destructive efficiency. Personally, I see the possibilities of its wider use than just metallurgical waste. However, it is always necessary to perform additional tests for a particular matrix and according to the needs of the given customer.

V Praze, dne 21.1.2020

Doc. Ing. Vladimír Kočí, Ph.D. MBA.

EXPERTISE:

A) GENERAL INFORMATION:

Technology: **Technology for Catalytic Detoxification of Persistent Organic Pollutants**

Aplicant:

Name: E&H Services, Inc.

Street: Budějovická 618/53

ZIP, city: 140 00 Praha 4, Krč

ID: 24718602

VAT: CZ24718602

Opponent:

Name, surname: Ing. Milan Jakubek, Ph.D.

Street: Garážní 2000

ZIP, city: 735 32 Rychvald

ID/Personal id.: 880120/5611

VAT:

Verification body:

Name: CEMC ETVCZ

Street: 28. pluku 524/25

ZIP, city: 101 00 Praha 10

ID: 45249741

VAT: CZ45249741

Purpose of the review:

The purpose of the review is to assess the technology of "Catalytic Detoxification Technology for Persistent Organic Pollutants" by E&H Services, Inc. within the framework of the Quick Verification of Order No. 500 21, implemented in accordance with the General Verification Protocol (GVP 1.3) under the EU Pilot Program for Environmental Technology Verification (EU ETV).

B) Review:

1.1) Description/principles clear?: ☒ YES ☐ No

Comment:

The copper-mediated destruction (CMD) transfer of new POPs technology from the laboratory to a full-fledged unit describes the theoretical principles of technology in the Introduction and Area A: CMD technology description. Also the basic technological scheme of CMD technology is described within the control. Within the chapters are the basic principle equations of chemical reactions that contain your essence of destructive processes within the technology. The basic reactor parameters in terms of temperature, pressure and time are also described.

1.2) Clear and verifiable performance claim(s)? ☒ YES ☐ No

Comment:

The performance parameters are defined as the basic technical parameters of the reactor engineering which is pressure: atmospheric, temperature: 250 to 300 ° C, reaction time 3 to 4 hours, phase used - solid, liquid or gaseous, catalyst: copper with hydrogen donor. The performance parameters from the destruction point of view can be found in the details-first experiment chapter or the destruction test performance can be traced in the records of individual technology verifications from 2002, 2003 and 2005. CDC unit at input concentration of toxic substances: 1-100 µg I-TEQ / t ensures a total chlorine removal efficiency of more than> 99.9%, with a capacity of 250 kg / 6 hours for metallurgical dusts on baghouse filters and electrofilter capture - the final deposit after wet flue gas cleaning.

1.3) Technology shows innovative characteristics?: ☒ YES ☐ No

Comment:

From a technical point of view, this is a unique innovative technology from the very perspective, as this technology is made to measure, where the individual components are individually unique, including their assembly in the technological unit. Innovativeness also shows the use of copper catalyst and high destruction efficiency for individual phases of solid, liquid or gaseous. The advantage of the technology is also the application for small quantities of destroyed material - thus innovation in the platform of technology transfer and transport to a specific position. An interesting innovation is the destruction of even very persistent pollutants as POPS or very specific substances with endocrine disruption or genotoxicity properties. When compared to other CMD technologies, innovative design, phase-oriented and processing elements are used, including the flow of technology flows and the use of energy / heat. The authors also present environmental comparisons with CDC, BCD or GPCR technologies both in terms of natural resources (media intensity and application) and, for example, temperature and thus the cost of the heat source.

1.4) Potential to meet user needs?: ☒ YES ☐ No

Comment:

The company is currently struggling with local sources of POPs pollution, such as PCBs, OCP, BFRs or fluorinated substances. Wastes containing these substances POPs need to be disposed of frequently in local sources of this pollution - from this point of view, the advantage of easy transport of technology in the form of a universal container is advantageous. There are also potentially satisfactory parameters for potential users in terms of the manageability of the technology itself and its operation, and the demands on operating media and the economy of operation. From the point of view of environmental satisfaction of users is especially interesting parameter: almost 100% efficiency of POPs disposal both on input and output components in different phase forms. Also interesting is the possibility of the user to return the wastes back to the disposal process of the course of disposal and also to prevent the leakage of hazardous substances into the environment and thus increase the ecological situation at the place of disposal.

Because of the amount of local pollution, there is a huge demand for these technologies in terms of both transport and POPs disposal efficiency. The target group can be, for example, local sources of pollution, such as industrial enterprises, chemical or hazardous waste dumps, both legal and illegal.

1.5) Fulfilling legal requirements (limited to VB's expertise)?: ☒ YES ☐ No

Comment:

The technology itself does not contain hazardous substances, does not release hazardous substances, does not contain radioactive emitters and uses standard physical processes. From this perspective, I do not see any major legislative shortcomings that would prevent the application of this technology. Technology itself is also not combustion and does not emit emissions. The actual fulfillment of legislative requirements will be rather based on local installation of technology. In conclusion, I am not aware of the current legal requirements that would prevent the application of technology itself.

1.6) Life-cycle aspects described?: ☒ YES ☐ No

Comment:

From a technical point of view, technology itself contributes to environmental policy and requirements. Within the application of the technology endocrine substances, POPs or substances with the character of xenobiotics or genototoxic substances are destroyed. The advantage of the whole technology is a closed cycle, which also prevents the release of dangerous substances into the environment.

1.7) Technology shows environmental benefits?: ☒ YES ☐ No

Comment:

The LCA / LCI report is not documented in the documentation provided. From a technical point of view, I do not see any significant or technological negative environmental impacts according to the submitted technical documentation and description of chemical processes.

1.8) Clear and verifiable performance claim(s)?: ☐ YES ☐ No

Comment:

Performance parameters are documented in postponed verification records of the technology testing, including the demonstration of the effectiveness of destruction experiments. There is also a methodology to verify the effectiveness of destruction tests from the perspective of, for example, the determination of cytotoxicity or genotoxicity also with regard to the OECD or other binding documents or guide lines.

1.9) Ready-to-market?: ☒ YES ☐ No

Comment:

The technology is located in shipping containers according to international standards and dimensions in Ostrava Radvanice. The authors also mention its used in Poland and other places. From this point of view, the technology is functional and operational and therefore ready for launch. However, it is necessary to resolve the small legislative requirements in terms of distribution to specific national markets, such as electrical compliance, etc.

1.10) Prototype in advanced stage of development?: ☒ YES ☐ No

Comment:

From the point of view of the existence of the proto-type itself (tehnology - functional sample) and its application at several workplaces and the solutions for its transport and start-up, we can conclude that the state is in an advanced stage ready for distribution to the market. However, it is of course necessary to eliminate minor defects and technical solutions that could be optimally used by the user.

C) ASSESSMENT OF EXISTING TEST RESULTS:

2.1) Tests results are available?: ☒ YES ☐ No

Comment:

For example, Project Progress Report # 7 is available, which describes destructive samples of this technology on samples of destroyed material in cooperation with several partners. In the individual tests and verified there are enough verified parameters that fully characterize the technology and process. In individual experimental processes it is possible to find, for example, the parameters of the destruction efficiency of substances, focusing eg on halogenated substances.

2.2) Test plan is available?: ☒ YES ☐ No

Comment:

The above document points to the tests carried out in the FOKS project and also according to other documented documents within the POPDESTR project. The results of PCB and PCDD / F analysis are also documented as a protocol of analysis from experiments, which were evaluated by an accredited laboratory of the Institute of Public Health in Ostrava in 3003 or 2004, which proves the efficiency of the technology on the given samples.

2.3) The test plan is appropriate?: ☒ YES ☐ No

Comment:

The test / test plan is sufficiently described.

2.4) Test methods available (standards)?: ☒ YES ☐ No

Comment:

Test methods for verification are available both in terms of concentration measurement by physicochemical methods, for example according to ISO17025 POPs, PCB or PCCl determination. Biological methods for the determination of cytotoxicity and genotoxicity, which are defined and declared, for example, by OECD International Standards, are also developed and fully available.

2.5) Test methods are described?: ☒ YES ☐ No

Comment:

Text above, these methods are also described by national standards and regulations, as well as transnational ISO regulations, OECD guidelines, including validated methodologies and available literature, and results demonstrating the suitability and applicability of these methodologies.

2.6) Test methods are appropriate?: ☒ YES ☐ No

Comment:

From the chemical-physical point of view as well as from the biological point of view, the methods and techniques used and selected are suitably applicable. From its own point of view, the tests could be extended, for example, by analysis of heavy metals or total organic carbon.

2.7) The test methods are reproducible?: ☒ YES ☐ No

Comment:

2.8) The test methods are accurate?: ☒ YES ☐ No

Comment:

Authors document test protocols of individual analyzes, using methods that are accredited or validated and contain uncertainties of determination that correspond in statistical terms to the accuracy of the whole. These protocols are sufficient in view of the requirements of the customer or user in other destruction experiments may change and other method accuracy may be required.

2.9) Test results are available?: ☒ YES ☐ No

Comment:

The authors demonstrated the results in given protocols and documents from the project where the technology was tested.

2.10) Test results are in accordance with the Technology Performance Statement: ☒ YES ☐ No

Comment:

Yes, given the protocols documented by the authors, from the PCB and PCDD / F point of view, the destruction efficiency and hence the efficiency of the technology on the basis of ≥ 99% can be found.

D) CONCLUSION:

The technology described by the authors in the enclosed documentation is applicable and applicable to modern industrial environmental applications. The advantage of this technology is a closed cycle, described principle of technology, the possibility of destruction of small quantities or high efficiency of technology or recovery process. However, from a technical point of view, it is necessary to continuously verify and innovate processes according to the current legislative requirements or requirements of individual users and matrices to be disposed of. From my professional point of view, the technology is functional and applicable and has been verified in the form of several test or verification protocols. Also the technology was described according to the attached documents in the projects POPDESTR or FOKS. **The technology can therefore be considered as proven.**

V Praze dne 22.1.2020

Ing. Milan Jakubek, Ph.D

{Jméno a příjmení zpracovatele posudku,podpis}