European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

TESTNET

A pilot for developing a technology-specific ETV

www.est-testnet.net

Co-Funded by :

SIXTH FRAMEWORK PROGRAMME

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Brief introduction to the TESTNET project

TESTNET is a pilot for developing a technology-specific ETV …

TESTNET - *Towards European Sectorial Testing Networks for Environmentally sound Technologies* - is a European project selected to design, develop and test an **Environmental Technology Verification** (ETV) system. TESTNET aims to develop an independent system to provide the market with credible performance data.

What does an ETV ?

The development of ETV programs is a recent phenomenon originating from North America. Just as ecolabelling provides guidance to consumers seeking to purchase "environmentally friendly" products, verification programs have been designed as a means to accelerate market acceptance of innovative technologies.

This is achieved by providing technology users with information about performance, thereby decreasing the uncertainty in purchasing decisions.

Verification can be defined as the mechanism or process for establishing or confirming the performance of a technology, product or process, under specific, predetermined criteria or protocols and adequate quality assurance procedures.

JRC/IPS (EUR 22933 EN – 2007)

Benefits of an ETV

Surveys and the analysis of outcomes based on actual or potential market penetration scenarios showed that sold (or to be sold) ETV verified technologies achieve emission reductions and thus have positive impacts on the environment and on human health.

ETV helps firms with regulatory compliance, contributes to technology acceptance by end users and promotes scientific advancement.

JRC/IPS (EUR 22933 EN – 2007)

Verification must not be confused with certification. The former involves the independent assessment of a technology's performance without any judgement of it. Certification normally goes one step further by guaranteeing that every specimen of a product is meeting standards or defined performance criteria. ETV will not rank technologies or compare their performance, neither will it label technologies as acceptable or unacceptable.

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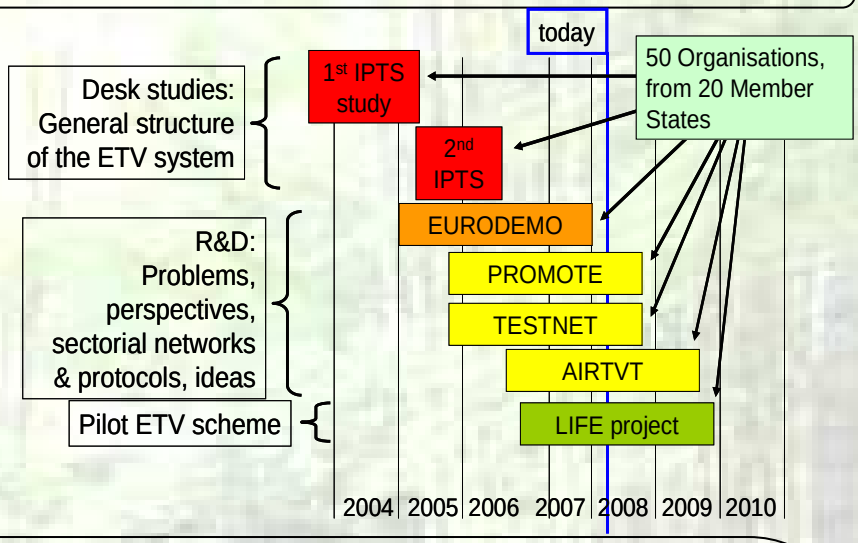
TESTNET is cooperating with other EU verification system projects

The overall strategic objective for a European system for ETV is to enhance the application of innovative Environmentally sound Technologies (**EsT's**) by purchasers and permitters, both inside and outside of Europe. Since 2005, the European Union has launched a number of studies (IPTS) and of research and demonstration projects in this field.



EURODEMO

European coordination action for Demonstration of efficient Soil and Groundwater Remediation

http://www.eurodemo.info

PROMOTE

Efficiency Control and Performance Verification of Improved Approaches for Soil-Groundwater Protection and Rehabilitation

http://www.promote-etv.org

AIRTV

Testing network for verification of air emissions abatement technologies

http://www.airtv.eu

TRITECH ETV

Pilot project to develop a EU wide scheme for validating the performance of environmental technologies

http://www.lifeetv.com

ETV a tool for ETAP objectives

Since 2004, the European Union has adopted the Environmental Technology Action Plan (*ETAP*). Key objective is to encourage the development and wider use of environmental technologies as one of the measures to ensure Europe's competitiveness in global world economics.

One of the identified ETAP priorities is to bridge the gap between innovation and application. Implementing ETAP includes improved testing, performance verification and standardisation of environmental technologies.

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TESTNET objectives and technology fields

TESTNET objectives

TESTNET objectives are met by:

- the identification of promising EsTs and innovative solutions for verification;
(WP1: Technology and market prospects – p 6-7)

- the design of a system for testing and verifying new and innovative EsTs;
(WP2: Verification system – p 8-9)

- a sustainable follow-up of the verification system and networks, including the involvement of relevant stakeholders in the networks.
(WP5: Business plan – p10-11)

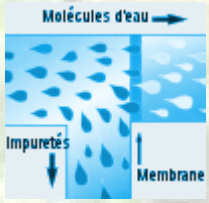
- the validation of the functionality of the verification system for the selected technology areas and for different types of organisational solutions;
(WP3: Validation of verification system – cases – p12-27)

TESTNET technology fields

TESTNET is covering two EsT areas: water technologies and cleaner production.
In both technology areas, the relevant Monitoring Technologies are included.

Water technologies

Water technology concerns drinking and process water, water reuse and waste water treatment. The application areas are mainly industrial, municipal and agriculture.



Cleaner production

Cleaner production is a rather wide area. It focuses on industrial applied technologies for the reduction of waste, improved use of raw materials, reduction of emissions to water, air and soil, etc. Industries like chemistry (bulk, specialties and fine), food, pharmaceutical, agro, (solid) waste treatment etc. are typical application areas.

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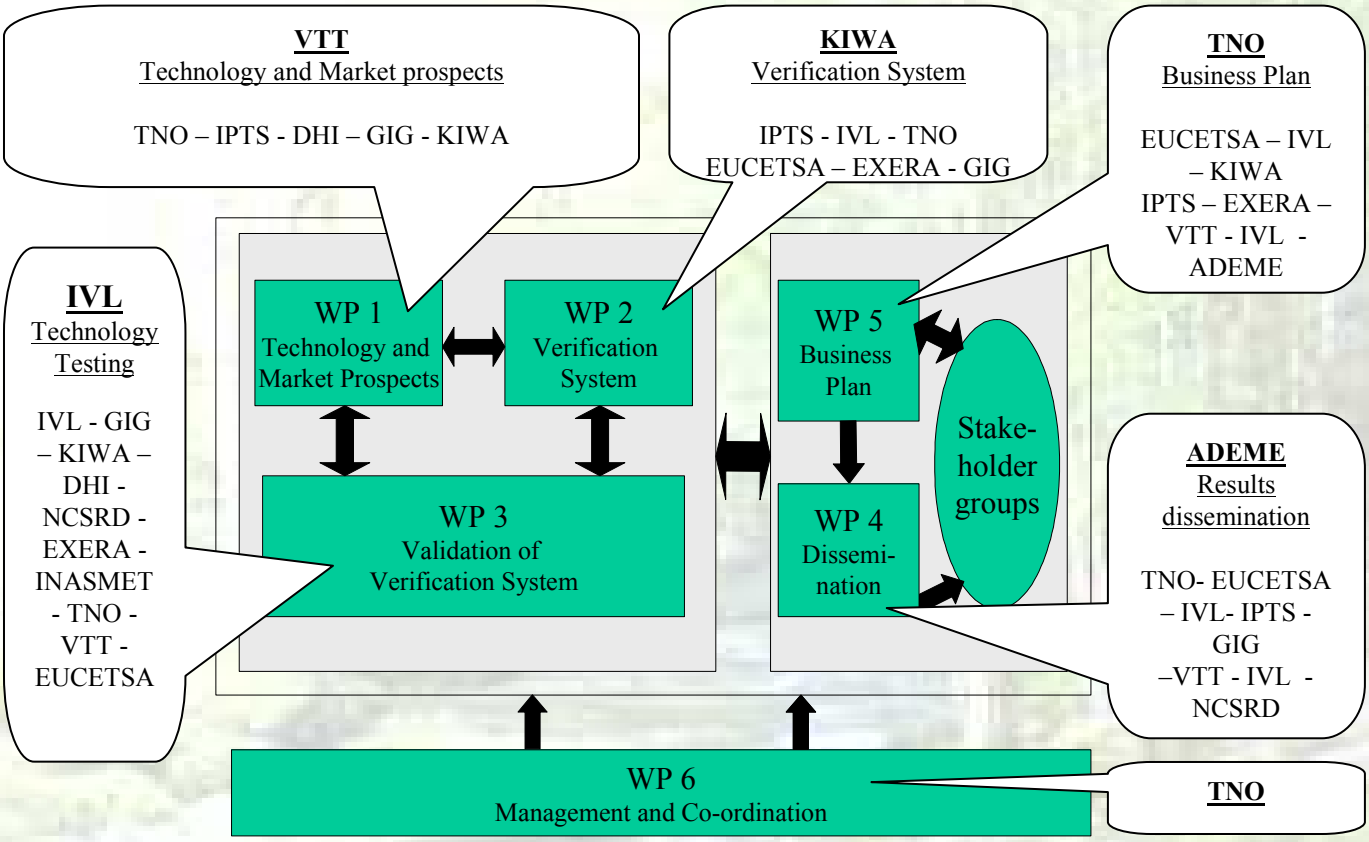
TESTNET Who's doing what



TESTNET cases studies for the validation of verification system

Type of case	Technology	Coordinator	
Water Technologies			
Monitoring of drinking & surface water	Bio monitoring [Toxcontrol]	DHI (& Exera)	DK
Monitoring of waste water	Optical monitoring [s::can spectrolyser]	DHI (& Exera)	DK
Water disinfection in food industry	Disinfection by oxidation processes	KIWA	NL
Water Treatment	Fuzzy filter	VTT	FI
Cleaner production technologies			
Recovery system in biomass and waste power station	Membrane technology for flue gas condensate	IVL	Sw
Treatment process in metal and waste industries	Plasma technology	INASMET (& IPTS)	Sp
Hydrocarbon recovery in petrochemical industry	Gas separation using membrane permeation process	NCSRD	Gr
Production line in mining industry	Cleaner pipe production	GIG (& TNO)	Pl

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Technology and market prospects

Key issues to support development of a European ETV system in Water Technologies and Cleaner Production areas

The TESTNET project examines the potential and challenges of a European ETV system especially in the areas of water technologies and cleaner production (incl. monitoring technologies related to these two technology areas).

A prospective approach that covers the pre-market, close-to-market and market diffusion phases of EST development is considered important when examining the technology and market developments. In this way, unfortunate institutional lock-ins due to a too rigid ETV system that cannot deal with new emerging technologies should be avoided.

Other key issues that contribute to successful implementation of an ETV system are stakeholder commitment and identification of interesting subsets of ESTs with significant environmental and/or health impacts.

Future Outlook on Water Treatment and Future Outlook on Cleaner Production

In the context of water treatment technologies (and related water quality monitoring) and of Cleaner Production , promising environmentally sound technologies and innovative solutions possibly suitable for verification are identified. Different kinds of technological solutions and societal developments and related constrains in order to develop the ETV system sufficiently responsive in view of future markets are examined.

Information on technological and societal developments that may affect the decision-making processes of different stakeholders, such as technology developers, purchasers, permitters, financers and researchers is provided to support building the ETV system.
Possible roles and contributions of ETV systems in the dynamics of RTD activities and market entry of water treatment technologies (and water quality monitoring) and of Cleaner Production are identified.

To go further: future outlook on water treatment and future outlook on cleaner production reports:
http://www.est-testnet.net/servlet/KBaseShow?m=3&cid=16042&catid=16067

Future Outlook on Water: Main results and recommendation

When looking at the developments of monitoring and treatment technologies, it is possible to see that they will enable fast and remote detection and control of water quality and quantity in water resources, supply and sewer systems and in industrial and agricultural water systems. The set of existing and novel techniques will result in a reduced need for water abstraction from natural resources, lower water consumption, better protection of ground- and surface-water, costs savings and hygienic safety.

There will be new opportunities for the control and treatment of water processes that will lead to efficiency improvements in the management of resources, and the quality of outputs and better environmental quality. The improved understanding of chemical process supports the development of new water quality monitoring and treatment technologies which enables better modeling and simulation and will ultimately lead to improvements in the planning, development and management of water resources. The ETV system should thus in the short time be ready to verify new sensor and measurement technologies, monitoring systems, as well as new biological, chemical and physical water treatment technologies.

R&D landscape of water monitoring and water treatment based on the Micropatent database for the years 1995-2006.

Future Outlook on Cleaner production: Main results and recommendation

Cleaner Production (CP) is a very broad and complex concept, including a wide range of innovation themes. CP approach is strongly eligible approach in our society and especially cost savings tend to favour clean production. In a narrow sense CP refers to process innovation, and an effective ETV-system should be based on a holistic life cycle assessment.
In designing the ETV system in CP scope it is extremely important to consider the possible overlaps between ETV system (directed to new technologies and innovations) and existing certified environmental management systems (directed to actual production plants/processes), like ISO 14001 and EMAS, as well as the other environmental analyses linked to LCA and eco-labelling. A new verification system should be synchronised as much as possible to the existing systems in order to avoid extra cost.
Verification protocol is urgent especially in the Clean Production areas as follows: 1) New business models in manufacturing industry, 2) Process intensification in chemical processing technologies, 3) ICT based control systems in CP and in achieving CP, 4) Purification and formulation engineering in chemical processing technologies, 5) Biorefinery solutions, 6) Nanotechnological applications, 7) Life cycle material design.

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Recommendation for a European system for Environmental Technology Verification

Starting points for the design

The experiences with the TESTNET case studies – presented further in this document - have shown the general approach of ETV can be summarized by three phases:

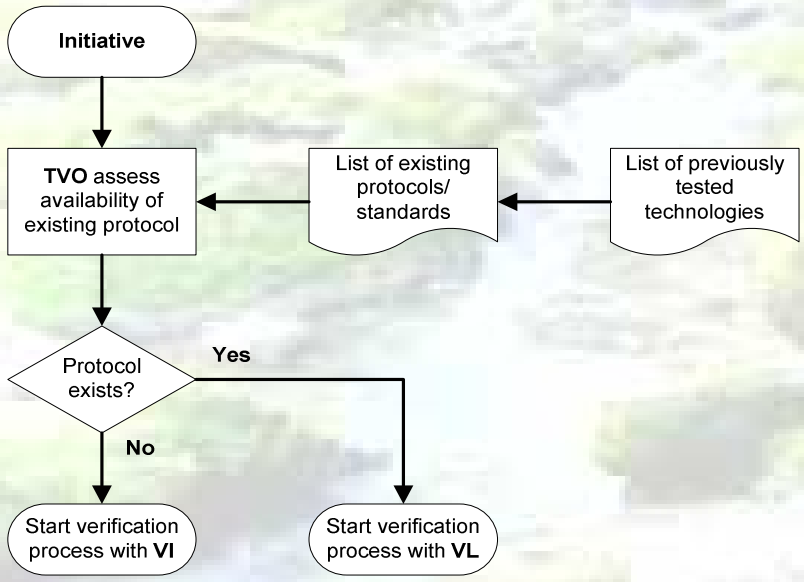
- Phase 1: The Initiative process (Contact)
- Phase II: The Verification process (Application and Assessment to be split in Start up Protocol – and Testing procedure)
- Phase III: The Verification procedure (Publication – Awarding ETV logo)

Because of the impact of the needed level of expertise & experiences for a successful Phase II the initiative procedure (Phase I) is introduced by the TVO (Thematic Verification Organisation) to decide and to give the lead for the Verification process to a Verification Institute (VI) or Verification Laboratory (VL).

Impact of presence or absence of pre-existing protocol on the process of the ETV system

As shown in the figure below by the absence of already accepted/validated international standards and protocols the lead for the verification process is given by the TVO to a qualified Verification Institute to set up a dedicated protocol, and if already accepted/validated standards and verified protocols are present the lead for the verification process is given by the TVO to a qualified Verification Laboratory.

The Verification Process (Phase II) to be split in Start up -, Protocol – and Testing procedure will be finalized by the Verification procedure (Phase III) for the TVO to decide the award yes/no of the ETV logo.



European ETV - Process with VL or VI (flowchart)
INITIATIVE procedure

A producer, an end user organisation or a branch organisation contacts the TVO (Thematic Verification Organisation), who then-if a suitable protocol does not exist-will appoint a qualified VI (Verification Institute) to lead the Verification process. If a suitable protocol is available and is expect to be used without too many changes, TVO will appoint a qualified VL (Verification Laboratory) to lead the Verification process.

This is based on the fact that the TVO in time will have information of all previously developed protocols and tests performed, and therefore can suggest coordinating/timing of tests to be done.

To enhance a specific technology the TVO also can call for initiatives

Organisation

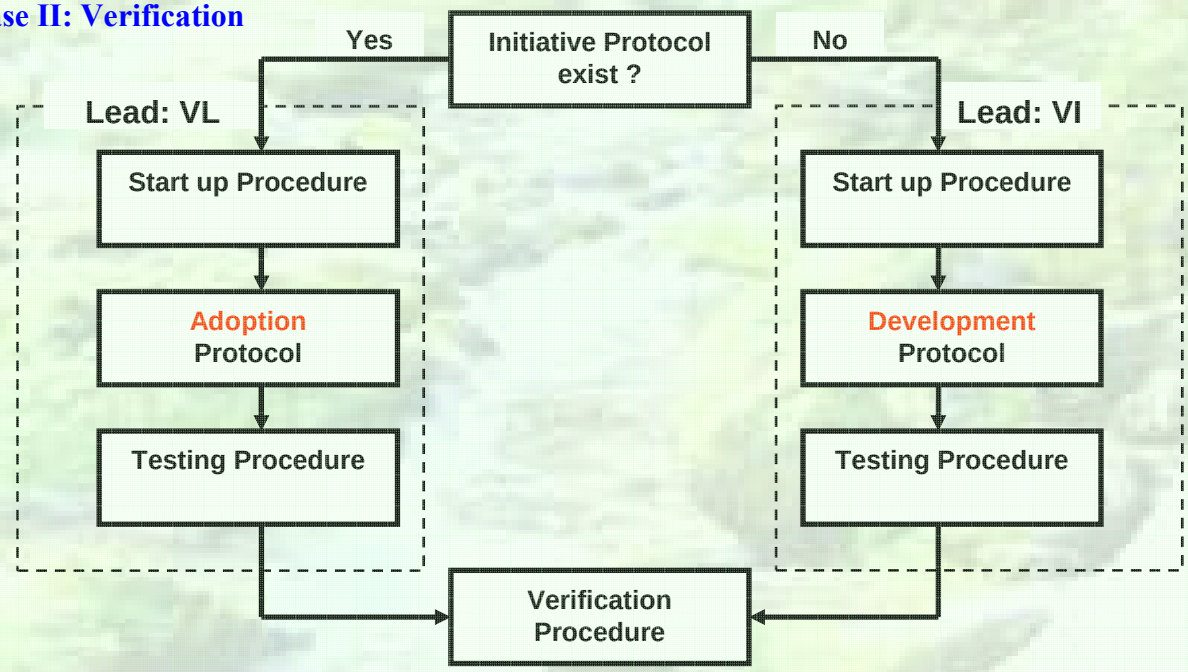
Testing and verification are strictly separated; qualifying, supervision and auditing are of vital importance. To safeguard competence and confidence in reliable test plans and subsequently credible test results the VIs and VLs had to be accredited and qualified by severe criteria.
The market is involved in developing the protocol by a formally installed Board of Experts (BoE) per sector. By involving all stakeholders (including their competitors!) confidence had to be regulated. Support is felt as a key value. The involvement of stakeholders is substantial. They have a decisive voice in the scheme; the protocols require their approval. To keep the lines of communication and understanding short a Board of Experts belongs to (is run by) the TVO.

The system is designed in such a way that expansion with other or new Thematic Verification Organisations in other sectors is possible. In such cases a clear demarcation between the conformities and non-conformities of the different technology area is required in order to avoid overlap.

The TVO has the lead and anticipates in the main process: the operational aspects of the verification scheme.
Supervision of the operational aspects is done by the EU ETV team by evaluating the audit reports of the several accreditation bodies and by evaluating the quality assurance data.

Phase I: Contact and selection

Phase II: Verification



Phase III: Reporting and awarding

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Business plan ETV for Technology areas Cleaner Production and Water treatment technologies and the related monitoring

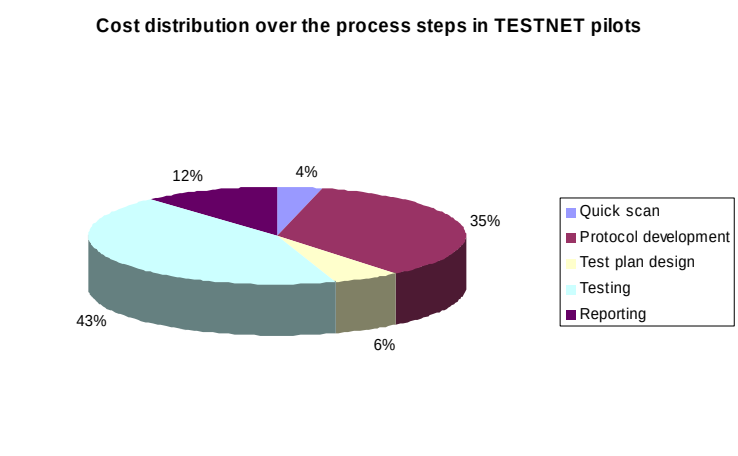
Introduction

Within the TESTNET project the development of the process for verification of environmentally sound technologies and the testing of this process through pilot cases should give insight in the conditions for a sustainable follow up of such a verification system. One of the goals is to transfer the lessons learned during the project into a business plan for implementation of an ETV system for the technology areas under consideration in the project.

The purpose of this Business Plan is to present the strategic and operational plans for starting and operating such a system and to show the financial conditions to achieve that. This will provide a platform for discussion with policy makers, environment industry representatives, technology applicants and other stakeholders, at future consultations for an actual implementation of an EU-ETV system.

Key issue here is the design of a solid organizational structure, fitting to the stakeholders needs for a fast, cheap and credible system. The organizational structure must guarantee the independency of results from the verification process and, at the same time, it must enable flexibility in meeting market needs. Since Competence and confidence is a guiding principle, the Thematic Verification Organization (TVO), composed by (private) professional institutes, will be the key player to assure credibility and to reduce costs and bureaucracy.

Financial consideration

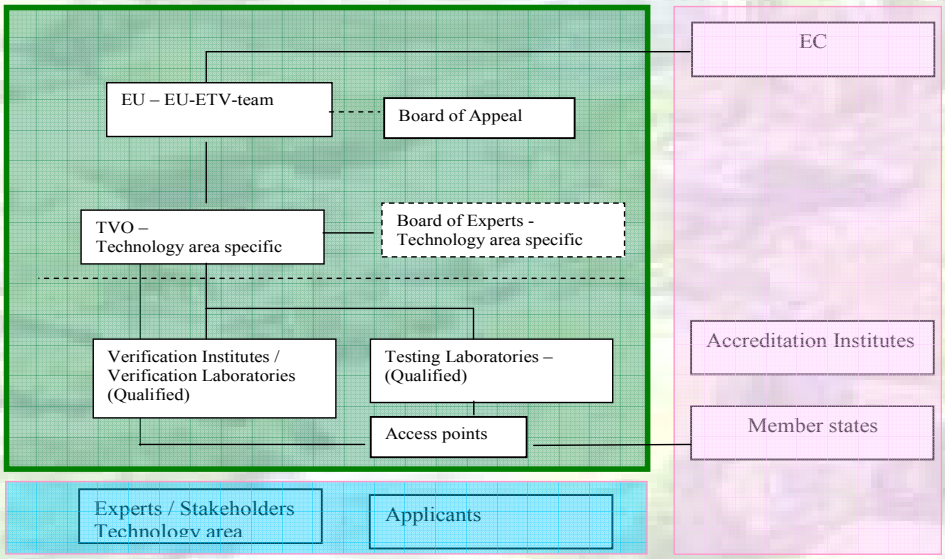


Primarily designed for speeding up market entrance of innovations as developed by SME's, the willingness to pay is an important factor for the success and continuation of the system. Both in our pilot tests and through consultation of stakeholders during the project we identified that the variable costs (protocol development, testing (see graph above) should be limited to attract applicants. External support to SME's for the verification process is likely to be needed. This opinion was also confirmed in the results of the recent EU Public Consultation on ETV.

Business plan: Organization and management

The Business Plan covers the establishment and continuation of a European Verification system for an Environmentally sound technology as researched in the TESTNET project. It provides a situation sketch, offering the context and rationale for the system and shows the strategic considerations for designing and operating the system. The services to cover through the EU-ETV system and a description of the system are part of the plan as well as organizational details and operational plans for starting and running the system. A financial analysis for operating the system concludes the plan. Running the system will require public funding for general system issues (including protocol development).
It is proposed that applicants pay a limited fixed fee for the initial screening of the technology and, apart from the testing costs, a percentage of the verification costs.

In order to create the best balance in the need for credibility, speed and costs of verification, the preferred organizational structure of the ETV organization is presented below. Public-private partnership has been taken as a starting point for the organisation model. Independency has to be reached by separating entities at relevant boundaries without building a complex bureaucratic structure.
- A lean organizational structure for bodies acting in the primary process as demarcated by the green boundaries.
- The other domains show entities that are connected to the organization structure because of their link to the system.



On top of the organization acts the EC, initiating the ETV-system and controlling the programme.
The core process is covered by an EU-ETV team as part of the EC. This EU-ETV-team is supervising a public or private entity under their subcontract which is responsible for running the day-to-day process of the EU-ETV. A network of public/private institutes is performing the actual process of verification and testing. In order to safeguard independency, there must be a clear understanding of position, roles and responsibilities for each entity within the organization. The Business Plan (TESTNET project deliverable under conditions of confidentiality) describes these roles, tasks and responsibilities.

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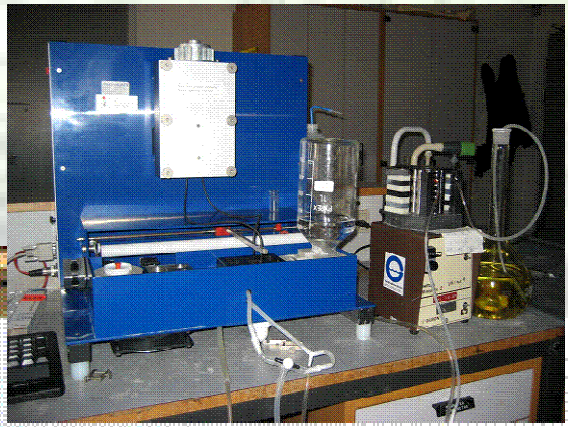
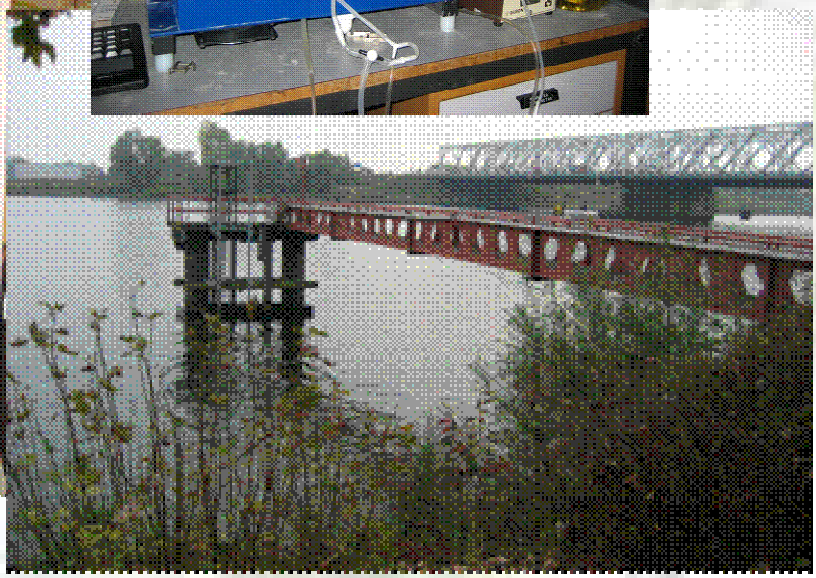
Evaluation verification: Biomonitoring case [TOXcontrol]

Short technology description

The TOXcontrol biomonitor is an on-line water quality monitoring system. It is an automatic instrument, which uses freshly cultivated light emitting bacteria (Vibrio fischeri) as a biological sensor. Toxic substances present in the water sample destroy some amount of bacteria, leading to a decrease of the light emitted by the bacteria. The instrument calculates the inhibition factor as described in the ISO 11348-1 Standard. Measurement parameters can be selected according to the parameters described in the standard: dilution ratio, exposure time…More information can be found in the Web site of the manufacturer (www.microlan.nl).





Partners

MicroLAN (producer)
DHI (Testing lab. lab tests)
KIWA (Testing lab. field test)
EXERA (VI)

Evaluation verification: Biomonitoring case [TOXcontrol]

Protocols and methods

The verification process is based on the verification scheme adopted by TESTNET for the setting up of a European Environmental Technology Verification system (EU-ETV). The process including a Verification Institute (VI) was selected.

The verification protocol [3] is based on two ISO standards:
• A "generic" standard, ISO 15839:2003 "Water Quality – on-line sensors/analysing equipment for water - specifications and performance tests"
• A more specific standard ISO 11348-1:2004 "Water Quality – Determination of the inhibitory effect of water samples on the light emission of Vibrio Fischeri (Luminescent bacteria test) – Part 1: Method using freshly prepared bacteria".

A draft version of the protocol based on the two standards was prepared by the Verification Institute (EXERA) and proposed to the Board of Experts on January 15, 2007. The verification protocol was adapted for biomonitoring, and some specifications could not be verified, as for instance linearity and bias. The test laboratory (DHI) prepared a test plan and submitted the test plan to the task group. The laboratory tests were performed at DHI during March 2007 and then the instrument was installed at a KIWA site for the field tests. The test report was delivered on September 2007 by DHI.

Test results (evaluation reports, available results and main findings)

The laboratory tests were performed according to the test plan developed by the laboratory, the instrument being considered as a "black box".
Some results should be considered with care, as the intensities of luminescence varied a lot, even when taking account of the "natural" decrease of luminescence – 90% - during a week of unattended operation. Moreover, statistical computation can be applied only when results are not dispersed too much.

The TOXcontrol biomonitor manufactured by microLAN B.V. is a tentative to develop an automatic on-line instrument – adapted from the manual method described in the ISO 11348-1 standard - which can be used as an Early Warning System for the detection of toxicity in drinking, surface and waste water. The measurement principle follows the manual method. It uses an interesting differential arrangement to detect toxicity in water samples. The laboratory tests revealed some problems preventing a continuous measurement that can be expected for an on-line automatic system. As this instrument is a new marketed one, we think that these problems might be solved by the manufacturer with additional tests.

Partners

MicroLAN (producer)
DHI (Testing lab. lab tests)
KIWA (Testing lab. field test)
EXERA (VI)

European testing project for Environmentally Sound Technologies

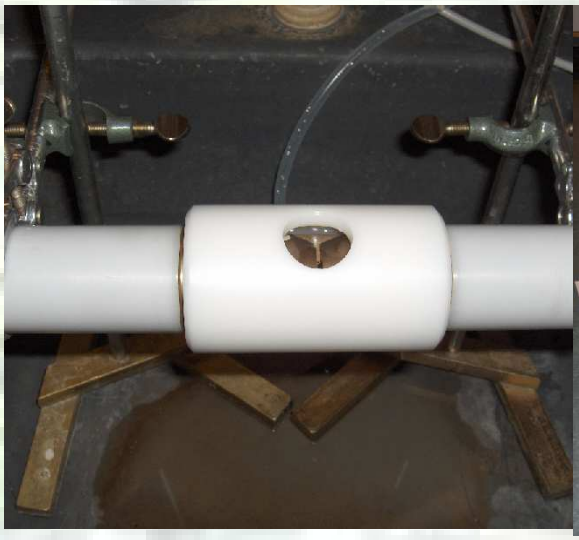
Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Optical monitoring case [S::can spectro::lyser]

Short technology description

The s::can spectro::lyser for waste water monitoring is a fairly recently marketed product, and represents the group of multiparameter sensors based on spectral UV-VIS absorbance measurements. New application possibilities are still introduced and have to be tested. The new application to be tested here is monitoring and process control on waste water treatment plants – specifically measurement of NOx to monitor nitrification and denitrification processes (possibly separated into Nitrate and Nitrite), Carbon source available for denitrification (possibly calibrated to COD) and Suspended Solids.

Spectrometer probes work according to the principle of UV-VIS spectrometry. Substances contained in the medium to be measured weaken a light beam that moves through this medium. The light beam is emitted by a lamp, and after contact with the medium its intensity is measured by a detector over a range of wavelengths. Each molecule of a dissolved substance absorbs radiation at a certain and known wavelength. The concentration of substances contained determines the size of the absorption of the sample – the higher the concentration of a certain substance, the more it will weaken the light beam. Extinction or absorbance stands for a ratio of two light intensities: The intensity of light after the beam passed through the medium to be measured and the intensity of light determined after the beam passed through a so-called reference medium (distilled water). There is a linear increase in absorption with higher concentrations.



Partners

S::can (Producer)
DHI (lead+Test lab.+Testing lab)
EXERA (VI)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Optical monitoring case [S::can spectro::lyser]

Protocols and methods

A suggested scheme for Environmental Technology Verification without a Verification Institute has been tested for water monitoring using technology where a test protocol was readily available and the test work was considered as straightforward – hence no need for a Verification Institute (VI), but rather a scheme suggesting a "fast track".

The laboratory test were performed at the Testing laboratory using an instrument delivered by the manufacturer inclusive a manual sample device, which can be mounted on the instrument in order to encapsulate the "measuring gap" of the instrument. The "measuring gap" of the instrument was selected to be 2mm, in order to cover the ranges of the parameters (nitrate, COD and suspended solids) to be tested in the application: activated sludge tanks on wastewater treatment plants. However, the instrument was not tested with suspended solids in the laboratory test, as it was deemed impossible to produce a stable reference of activated sludge in different concentrations.

The protocol to be followed was prescribed as "strictly EN ISO15839" including "Environmental Conditions" using a temperature test for both Nitrate and COD and interference tests for Nitrate (using Nitrite and PAX) and for COD (using Ferrichloride and PAX - commercial chemicals used for precipitation at wastewater treatment plants).

Test results (evaluation reports, available results and main findings)

According to the test plans the tests should be carried out during a period of 6 days for each of the tested variables – in total 12 working days. However, this schedule seems to be too tight. A total of 14 days were used (date replaces day no. in the result tables below) – mostly due to problems during the interference test using Ferrichloride.

Generally speaking the laboratory test was successful, and no major problems were encountered unless the mentioned problems with the interference test using Ferrichloride, where the iron made deposits on the optical windows – despite the effort to clean the windows between each measurement (incl. blanks) in 0.2N HCl, it was not possible to get consistent results. The protocol as described in EN ISO15839 was strictly followed, and the operation of the instrument did not require any changes in this unless a minor change during the test of response times.

It is recommended that the tested technology is verified as technology for simultaneous measuring of Nitrate, Chemical Oxygen Demand (filtered) and Suspended Solids in activated sludge at wastewater treatment plants with the reported performance characteristics.

Partners

S::can (Producer)
DHI (lead+Test lab.+Testing lab)
EXERA (VI)

European testing project for Environmentally Sound Technologies

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Evaluation verification: Disinfection by oxidation process case

Short technology description

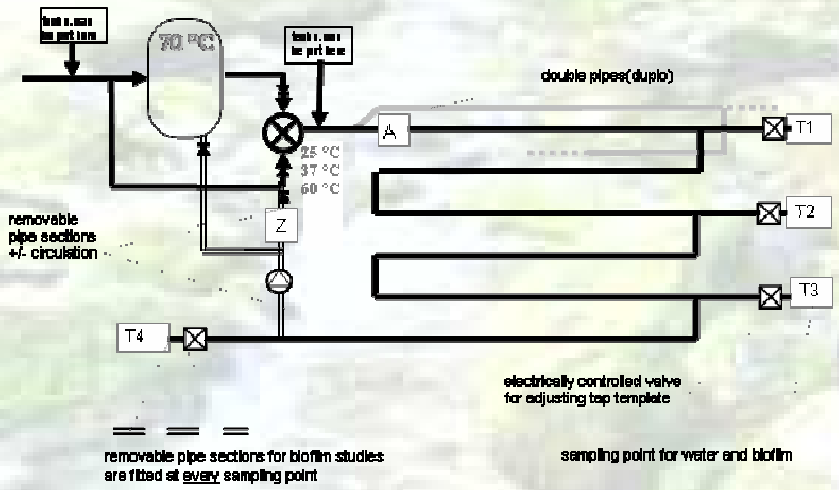
Water reuse in industry in general can result in environmental and economical benefits due to water savings and energy savings. For the food industry in particular the microbiological quality and stability of the water is of great concern. The case includes testing of a verification system for disinfection technologies used in the food industry to ensure good microbiological quality of reused water.

Suppliers of the following techniques were involved in this project:

➔ addition of chlorine dioxide;
Chlorine dioxide is a gas dissolved in water. It is formed – in situ i.e. in the treated water stream – by the reaction of sodiumchlorite and hydrochloric acid. Both chemicals are added to the water separately in the right amounts. Suppliers deliver systems that consist of containers with the two chemical and dosing/mixing devices.

➔ anodic oxidation;
With anodic oxidation oxidizing and disinfecting compounds are formed in situ by means of electrolysis. During the electrolytic process oxidizing compound are formed at the anode. These compounds could be chlorine, hypochlorite, hydroxyl radicals, oxygen radical.

➔ Copper/silver ionisation
The application causes an elevation of the copper and silver ion concentrations in the water.



Partners

Holland Water Technology, Ecodis, Prominent (Suppliers)
KIWA Water Treatment (lead+Test lab.+Testing lab)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Disinfection by oxidation process case

Protocols and methods

Jointly with the Verification Institute, the supplier must use the technology and the claim as the basis for determining what the specific conditions are for making use of the equipment that is to be tested during the Verification Procedure. The claim must fit in at least one of the following categories:
• A category 1 claim, aimed at the production capacity of the active compound by the equipment (output claim)
• A category 2 claim, aimed at achieving a particular value for the concentration of active substance and the residence time in the equipment (CT value), achieving a particular degree of lethality for micro-organisms to be specified (a CT value claim)
• A category 3 claim, aimed at achieving a particular microbiological deactivation (log reduction claim)
• A category 4 claim, aimed at removal of the active biofilm

For category 2 and 3 claims, the claim made by the supplier will refer to a specific type of indicator organism (non-pathogenic micro-organism for which data about its removal by purification processes can be collected, such data being representative for the elimination of a pathogenic micro-organism).

For category 4, a claim regarding the elimination of the active biofilm is relevant in particular for techniques where there is not only a disinfecting effect involved, but also gives longer-term benefits as a result of the effect on removing biofilm from pipe systems and storage tanks. This applies e.g. to copper/silver ionisation and chlorine dioxide. This does however imply that a biofilm must have been built up in the (test) pipe installation. The depositing of the biofilm and its gradual reduction thereafter (according to the claim) requires lengthy testing.

Test results (evaluation reports, available results and main findings)

A protocol for testing the performance of technologies for water disinfection for the food industry is developed and ready for testing.

Due to the fact of the high costs related to the claims laid down in the Verification Report there were no “real” tests performed. Based on a calibration of the output of a dosing a test result was handed in.
Normally a test report (to be evaluated) will be written by the Test laboratory, describing the tests performed and the results.

Main recommendations deal with the financial impact, which is the KEY for the realisation and acceptance for the system (European wide recognition) and the willingness for validation of the system to get a Verification Logo.

Partners

Holland Water Technology, Ecodis, Prominent (Suppliers)
KIWA Water Treatment (lead+Test lab.+Testing lab)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

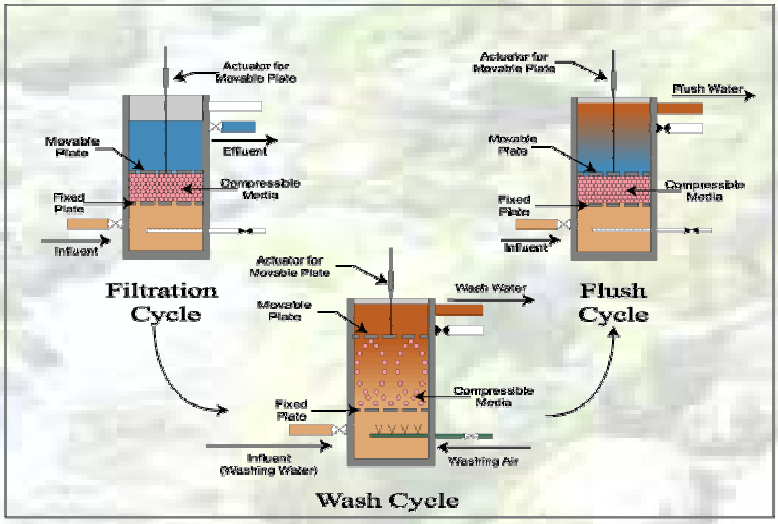
Evaluation verification: Fuzzy filter case

Short technology description

The Bosman Fuzzy Filter® is a compressible media filter for water and wastewater treatment systems. The square configuration Fuzzy Filter®, operating in an upflow design, achieves a high rate of solids removal through the use of synthetic fiber spheres. The low density and high porosity of the media result in large solids containment capacity per volume of media. Because the filter media is compressible, the porosity of the filter bed can be altered to suit influent characteristics.

The filter media also represents a departure from conventional filter media in that the fluids to be filtered flow through the media as opposed to flowing around the media as in sand and anthracite filters. These innovative features permit (dramatically) higher hydraulic loadings of 70 m3/m2·h of media and greater. Other filtration systems are typically limited to loadings of only 5 m3/m2·h to 15 m3/m2·h.

The Fuzzy Filter® utilizes air scouring in the wash cycle to clean the media. During the wash cycle, influent continues to enter the filter (filtered water is not necessary for washing) while an external blower supplies air in the bottom of the chamber to agitate the media. The media, which is retained between two perforated plates, is subjected to vigorous air scouring to free captured solids. Freed solids continuously exit the filter during washing. After the washing cycle, the media is returned to its compressed state and filtration is resumed. More information can be found in the Web site of the manufacturer (www.bosman-water.nl).



Partners

Bosman Water (producer)
VTT (Testing lab.)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Fuzzy filter case

Protocols and methods

The purpose of the protocol is to provide all necessary background data to verify the performance of the equipment when used to filter suspended solids from municipal wastewater. In addition, other most significant waste water quality parameters and environmental parameters are looked at.

The important parameters to be tested regard the function of the equipment are the amount and quality of filtered wastewater. Test parameters are flow, temperature and pressure measured at the site and suspended solids, total nitrogen, total phosphor and biological oxygen demand analysed in the laboratory. Functioning of the automatism of the filter and stability of the operation are also followed and potential problems registered. Environmental impacts are assessed mainly by measuring the consumption of energy and wash water.

The testing is carried out by characterising the influent (effluent from wastewater treatment plant) and examining the effect of the compression of the filter medium and the feed flow rate on the efficiency of purification and the functionality of the three operation cycles. The energy and wash water consumption as well as the loss of the filter media are also followed during the testing period.

Test results (evaluation reports, available results and main findings)

The equipment was installed in Apeldoorn, the Netherlands, at a municipal wastewater treatment plant as a tertiary treatment technique. The testing period was short for verification. In addition to tests carried out, the results of an earlier testing period at the same location were reviewed by VTT and found to be suitable for use in this verification.

As claimed, the system removes efficiently suspended solids and the satisfactory wastewater quality set for the Apeldoorn WWTP (test site) could be obtained. The automatism of the Fuzzy filter functions well and the filter reacts to the quality of the influent. In addition to this, there are no operational problems when large particles such as leaves and acorns are kept away from the influent water.

As the filter removes particulate matter, it also removes particulate phosphorus. Fuzzy filter does not remove soluble compounds. No detergent was needed because the influent was sufficient for washing. In a stable situation about 10 percent of the treated water was used for washing and returned back to the wastewater purification. The energy consumption of the filters was dependent on the cleanliness of the filters. No loss of the filter medium was noticed during the filtration.

Partners

Bosman Water (producer)
VTT (Testing lab.)

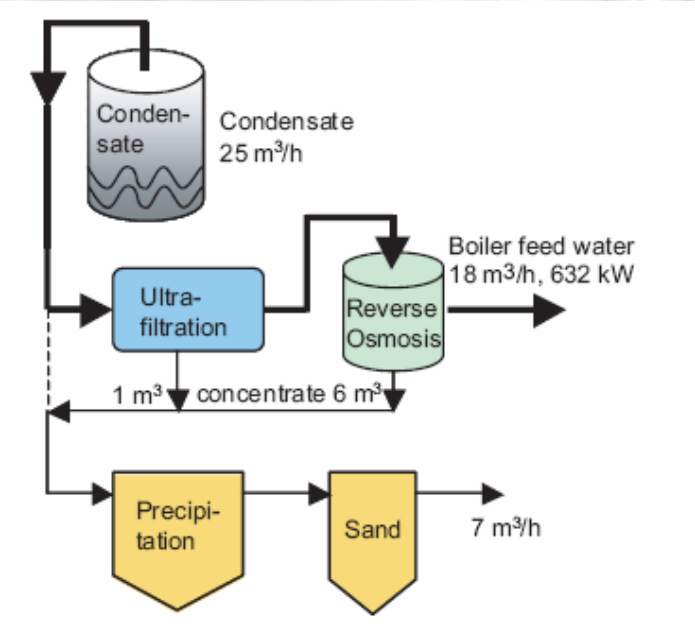
Evaluation verification: Membrane technology for flue gas condensate case

Short technology description

The technology to be tested is membrane technology consisting of ultra filtration and reverse osmosis, used in power station burning wet fuels, such as waste or bio fuels.

The treatment equipment installed at Händelöverket produces boiler water which is used to produce steam for electricity and district heating. The boiler water is produced either by using softened city water (which was also the case before the implementation of the treatment equipment) or by using desalinated exhaust gas condensate. Thus the requirement of the treatment equipment is set by the quality of the boiler water.

The main benefit of the membrane unit is to unable reuse of the hot flue gas condensate water as boiler feed water. The ultra filtration unit is used to separate suspended solids that would harm the osmosis membrane. The reverse osmosis membrane unit separate unwanted compounds like sodium sulphate, in order to gain a water quality sufficient for boiler re-use. In the studied case about 75 per cent of the condensate water is reused as boiler feed water (100 000 m3 per year). The reuse of water also results in a heat saving of approximately 3600 MWh per year. The remaining water (25 %) has to be treated by chemical precipitation or equivalent before discharge.



Partners

Mercatus Engineering (supplier)
E.on Händelöverket (customer)
IVL (Verifier)

Evaluation verification: Membrane technology for flue gas condensate case

Protocols and methods

The overall function of the technology to be tested is to reduce input of external water.
Important parameters to be tested regard the function of the recycling equipment i.e. the amount and quality of the produced water. Also the resource which includes the use of energy and certain chemicals are parameters that have to be looked at.

The treatment equipment consists of a number of techniques (unit operations) combined together. In this verification protocol the different step are described but the system is considered as a black bow where the incoming process streams are condensate from the exhaust gases of city water, combined with use of chemicals and energy for the treatment. The outgoing streams are the product (boiler water) and sewage water. Thus, the protocol does not deal with single unit operations, but the whole treatment equipment.

The test procedures and test methods of interest in this specific case are stochastic samples at different hot spots in the plant to verify that the sensors measuring valid the parameters are functioning satisfactory. Thus pH and suspended solids should be analysed prior to the UF unit. Conductivity should be analysed prior to the RO unit and conductivity and Si concentration prior to and after the EDI/MB units.

Except the verification of the sensors it is off course essential to verify the overall performance of the treatment equipment and thus it is necessary to keep track of all parameters that are given by the manufacturer in the requirement specification.
Energy and city water should also be measured to verify performance of the plant.

Test results (evaluation reports, available results and main findings)

The performance of the equipment, i.e. the capacity and the degree of separation, was good and according to the specification of the supplier. Thus, the claimed function of the equipment was achieved.
The waste that was generated could not be reported because of the fact that this was not documented at the plant. In order to give a complete picture of the equipment and its overall performance this information would be preferred. This would need 3-4 months of measuring. Although there is no record, the different waste fractions mentioned are existing. Also, waste will be generated when switching membranes and resins.
The energy and chemical resources values were established according to the stepwise EPD for the exhaust gas cleaning equipment. With the values for consumption of consumables and chemicals as well as energy use and man-power needed the running costs for the equipment can be estimated, except for the waste created. As such costs are country and site specific they were not calculated here

Partners

Mercatus Engineering (supplier)
E.on Händelöverket (customer)
IVL (Verifier)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Plasma technology case

Short technology description

A plasma may be defined as a conductive gas flow consisting of charged and neutral particles, with an overall charge of approximately zero. Plasma, when applied to waste disposal, can be better understood by thinking of it as an energy conversion and energy transfer device. Wastes are broken down into atoms, ionized, pyrolized, and finally destroyed as they interact with the decaying plasma species. The heart of this technology is that the breakdown of the wastes into atoms occurs virtually instantaneously and no large molecular intermediary compounds are produced during the kinetic recombination.

Vitrification, the process of converting materials into a glass or glass-like substance, is increasingly being considered for treating various wastes. Vitrification is conceptually attractive because of the potential durability of the product and the flexibility of the process in treating a wide variety of waste streams and contaminants. When accomplished through a thermal process, vitrification may destroy organic contaminants via pyrolysis or combustion. As a stabilization process, vitrification may immobilize inorganics by incorporating them into the glass structure or by encapsulating them in the product glass.

Many contaminated materials contain adequate quantities of the raw ingredients necessary to form glass. When such materials are heated, the ingredients melt together and actually form the glass in which the contaminants are immobilized. Additives may also be needed to create the special characteristics of some glasses.

Partners

INASMET (Testing laboratory)
IPTS (TVO)

Evaluation verification: Plasma technology case

Protocols and methods

The plasma based verification technology for APC (Air Pollution Control) residues from ISWI (Municipal Solid Waste Incinerators) transforms most of the waste in glass. The potential durability of the final product increases significantly, decreasing its volume simultaneously. As a stabilization process, vitrification immobilizes inorganic elements by incorporating them into the glass structure or by encapsulating them in the glass.
These new glassy materials must be tested in order to verify that the technology is able to transform the waste in such a way that it fulfils the legislation criteria for its management as a non dangerous waste. The legislation criteria for the management in landfill are set in the Council decision of 19 December 2002, where it is said that "laboratories shall have proven experience in waste testing and analysis and efficient quality assurance system". This proven experience, can be interpreted (in the Basque Country, Spain, for example) as the ISO 17025 mandatory.

Measurements concern analysis of the leaching behaviour of the plasma vitrified waste.
The product consists of a pilot plant that needs to be verified in order to be used as a demonstration prototype by the producer. The final product (the industrial plant) can not be verified as a serial item because is specific for each end user, depending on the amount of waste to be treated with this technology (scale factor).

Test results (evaluation reports, available results and main findings)

The values obtained in the eluates for all the components are well below the limits set by legislation for the acceptance of the treated waste in landfills for hazardous and also for non hazardous wastes. Even, most of the parameters fulfil the criteria for landfills for inert wastes.

The plasma technology performed successfully, showing that it is a powerful treatment tool that can be used not only with a specific formulation but with different vitrifying agents.

The leaching behaviour of the treated waste (leaching according to two procedures, as granular material and as monolithic material), indicates that the vitreous matrix obtained performs well not only in the monolithic form but also when its size is reduced to granular particles.

In addition, a significant reduction of volume, around 75 %, has been obtained due to the conversion of the powder waste into a glassy material.

Partners

INASMET (Testing laboratory)
IPTS (TVO)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Gas separation case using membrane permeation process

Short technology description

Gas separation is important in many industries from the development of natural gas and oil resources to petrochemicals and foodstuffs. Separations are in general needed to purify products to a required purity specification and to remove toxic or other environmentally damaging by-products. It is generally accepted that the greatest energy consumption (at least in the field of hydrocarbons) generally derives from the separation sections of the processes which may also account for in excess of 50% of the total capital costs.

There are four principal gas separation technologies, absorption, adsorption, fractional distillation and membrane permeation. The market leaders are absorption and distillation, both of which are capital and energy intensive. Adsorption, though less energy intensive than the above two technologies, is limited by the performance of the adsorbents, despite significant research focused on the development of new adsorbents.

Membranes have the potential advantages over currently existing technology, by offering the prospect of having lower capital and operating costs and using significantly less energy. In addition they do not use hazardous or toxic materials to achieve separation and their simple design enables straightforward expansion of capacity.

The products (membrane) provided for this case concerned the continuous separation of propylene from the refinery streams and catalytic process plants, to supply down stream users with polymer grade propylene for petrochemical applications and produce propane for storage and ethylene.

Partners

INOCERMIC (Producer)
NCSRD (Testing lab.)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Gas separation case using membrane permeation process

Protocols and methods

A Verification Protocol has been developed from scratch, since there was none existing for the specific technique. The protocol has been based on the structure already proposed in TESTNET.

The requirements that have been included in this Verification Protocol have been adopted by the Verification Laboratory, which has been qualified by the Thematic Verification Organisation, for the verification of the efficiency of membrane materials for:

- the separation of propylene from light hydrocarbon streams and especially from the refinery gas streams (FCC).
- the separation of propylene from the gaseous products of Hydrocarbons Steam Cracking.
- the separation of propylene from the products of Propane Dehydrogenation Reactions.

Two Test Plans have been drawn up and constitute Appendices of the Verification Protocol. The first Test Plan includes measurements that aim at testing the integrity of the membrane and at identifying the gas diffusion mechanism. The second Test Plan aims at measuring the membrane efficiency for separating propylene from a propane/propylene mixture, and at defining the yield of propylene and the conditions at which the optimum separation and yield are obtained.

Test results (evaluation reports, available results and main findings)

The supplier's (Inocermic GmbH) specifications (claims) for the product (silica membrane) were evaluated according to the tests described in the Verification protocol "Evaluating membranes efficiency to separate Propylene from light hydrocarbons streams".

The results according to the first Test Plan revealed that the pore size of the active layer is very close to the claim of the manufacturer (1nm), the layer is defect free, the diffusion of Helium is activated (which is in accordance with micropore diffusion mechanism - pore size <2nm), and that the permeability factor of several gases follows the kinetic diameter of the gaseous molecule, therefore the mechanism of diffusion is characterised as micropore diffusion.

The results according to the second Test Plan revealed that the maximum selectivity of propylene in a 50:50 mixture of propylene/propane is observed at 40°C and has a value of 8 bar, and that the membrane keeps its propylene separation efficiency for 4 hours under continuous flow of a 50:50 propane propylene mixture at 4 bar.

Partners

INOCERMIC (Producer)
NCSRD (Testing lab.)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

Evaluation verification: Cleaner pipe production case

Short technology description

The case study has been dedicated to the verification of cleaner production of fibre glass reinforced plastic pipes and fittings. The produced burning resistance and antistatic goods are designed to work in sever mechanical, corrosive, highly explosive conditions condition of underground mines for transporting methane, sand-water slurry and saline mine-water.

The tested technology is based on polyester resin cure process under the influence of initiators and catalysts placed on the glass fibre mat and fibre glass construction material.

The pipes production proceed in few stages:
- The resin with modifying additives preparation which behave the slow-burning and antistatic quality
- The resin and catalyst and initiator mixing process and then fibre glass impregnation
- The impregnated glass fibre and glass fibre mat winding to pipe core
- The resin hardening process in ambient temperature
- The pipe mechanical working

The VOC emitted in elementary stages and additional operation (production equipment cleaning) are carried away to cleaning in adsorption process by carbon active filter. The refinement air goes to atmosphere. The other way to decrease VOC amount is to apply low emission styrene contents resins and additional substances of low organic solvent contents.

Pipes are used for ducts in underground hard coal mine – in severe mechanical and explosive environment

Ventilation air intake installed on pipe manufacturing line

Partners
Plaston (producer)
GIG (Verification Laboratory)
TNO (Thematic Verification Organisation)

Evaluation verification: Cleaner pipe production case

Protocols and methods

Verification must consider whether the production conditions of raw materials and supplementary materials provided by the external suppliers comply with the clean production requirements.
- Assessment of the power consumption level (acc. to BREF).
- Determination of waste management model.
-Assessment of VOC emission level to the atmosphere and analysis of the monitoring system for emission reduction efficiency on a carbon filter. Level of VOC emission must not exceed reference values according to the Regulations of the Ministry of Environment of 5th Dec. 2002 on reference values for specific substances in the air (Dz. U no 1 of 2003 r. pos. 12).
-Assessment of the level of elimination of hazardous and harmful materials from the process.

Some other environmental dimension may be considered as analysis of supplementary processes (e.g. transport, loading) in terms of environmental nuisance and noise measurements (noise level in the environment in accordance with the Regulations of the Ministry of Environment of 14th June 2007 on permissible noise levels in the environment -Dz.U no 120 pos. 826).

Production stability is considered as one of the most important factor for assuring environmental technology performance. Any formal system either implemented partly or fully complying with complex management systems regulation such as ISO 9001//14001 or EMAS should be implemented.

Test results (evaluation reports, available results and main findings)

The applied moulding technology for manufacturing of pipes is usually used for manufacturing goods like boat hull, car parts, baths, different vessels, and others goods, which required mechanical strength and low mass. Often such technology is applied by SME and small workshops using manual works for limited series of goods. The production facilities consists usually one or more open production areas or big workshops.

The protocol worked out for the case might by used also for other SME applying this type of moulding. It might have significant impact lowering emission of Volatile Organic Compounds (VOA) from such production. The case shows, that it is possible to reduce emission reduction of VOC from the plant as follows:

Styrene - η =99,5%
Acetone – η=76,8%

The case also proves that for such technologies having a significant amounts of manual works it is important to assure stability of production process.

Partners
Plaston (producer)
GIG (Verification Laboratory)
TNO (Thematic Verification Organisation)

European testing project for Environmentally Sound Technologies

Towards a European Environmentally Sound Technology Verification System

TESTNET partnership

Coordinator:

TNO

TNO is the Dutch scientific research organisation with knowledge on environmental technologies, such as energy, water treatment, sustainable production, emissions, etc.
www.tno.nl

VTT

Technical Research Centre of Finland is an impartial expert organisation with the objective of developing new technologies and innovative solutions to companies and public sector organisations. **www.vtt.fi**

EUCETSA

The European Committee of Environmental Technology Suppliers Associations promotes the development and the dissemination of Environmental Technology, specifically for air, water, ground & waste
www.eucetsa.com

IVL

IVL is the Swedish environmental research institute dealing with many environmental issues and with specialisation in eco-efficiency and sustainable solutions for industrial production.
www.ivl.se

KIWA

Kiwa NV is a European organisation for testing and certification of products, processes and systems. Kiwa Water Research is a Dutch research institute for water and associated issues.
www.kiwa.nl

DHI

DHI Water & Environment is the Danish research and consultancy organisation with focus on urban water and industry, water resources and marine and coastal issues.
www.dhi.dk

EXERA

EXERA, association of industrial users, supports industry in evaluating and choosing measure equipment, automats, instruments, analysers and monitoring devices.
www.exera.com

CIG

CIG is the Polish central mining institute, with an Environmental Engineering Division which focus on energy saving and air protection, for industry and household
www.gig.katowice.pl

INASMET

INASMET is a Spanish technological research centre that focuses its activity on the frame of materials technology, their processes and environment. **www.inasmet.es**

NCSRD

NCSRD is the largest Greek multidisciplinary Research Centre, focusing (a.o.) on environmental and energy issues.
www.demokritos.gr

ADEME

French agency for environment and energy management,,Ademe performs research expertise and advisory services and supplies information to public, organisations and industry.
www.ademe.fr

IPTS

The mission of the IPTS is to provide customer-driven support to the EU policy-making process by researching science-based responses to policy challenges that have both a socio-economic and a scientific or technological dimension. **www.ipts.jrc.ec.europa.eu**