



**condorchem
envitech**



NUCLEANTECH

Condorchem Group

SOLUTIONS FOR LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE TREATMENT

www.nucleantech.com
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CONDORCHEM

Condorchem Envitech is an environmental engineering company offering solutions for the treatment of effluents, atmospheric emissions and solid waste for a wide range of industrial activities, including the nuclear sector for which a specific range of services and solutions has been created known as **NUCLEANTECH®**.

We offer our customers comprehensive solutions for environmental projects, covering the following services: analysis, planning, design, construction, installation, maintenance and the supply of plants and equipment for treating low and intermediate level radiation solid and liquid waste.

Since our company was founded in 1992, we have promoted the implementation of the best technologies available, to ensure that we offer our customers the most efficient solution for their specific needs, both on an environmental and financial level.

Condorchem Envitech has carried out over 500 treatment projects for different kinds of waste in over 30 countries.



NUCLEANTECH® SOLUTIONS

Our **NUCLEANTECH®** solutions range is especially designed for treating low and intermediate level radiation solid and liquid waste produced in different stages of the nuclear energy production process.

NUCLEANTECH® includes the following solutions:

NUCLEANTECH® Laundry

Treatment of laundry and sanitary waste waters which can be contaminated with low activity particles. This method enables efficient separation and optimizes final treatment, as it reduces the waste volume and thereby the disposal cost.

NUCLEANTECH® UF₆

The treatment of waste water generated during the production of UF₆ washing cylinders. Effluents are treated using evaporation to separate water and solid concentrate containing salts, mainly Fluorides and traces of uranium. This solution enables a strong reduction of final waste volume, hence reducing treatment cost.

NUCLEANTECH® H₃BO₃

Treatment of boron waste water used in the primary refrigerant of PWR nuclear plants. The nuclear-grade boric acid is concentrated by highly efficient vacuum evaporator and crystallizer, while the generated liquid waste is also reduced, thereby reducing the treatment cost of this radioactive waste.

NUCLEANTECH® NWDR

Treatment and minimization of solid waste with low level radioactivity generated in industries of the nuclear sector by means of pyrolysis. Our solution involves several steps: pyrolysis, washing syngas, catalytic oxidation and final polishing step by filtration. Strong reduction of waste volume converted in a small amount of charcoal.

NUCLEANTECH® Laundry



CONCEPT

The objective of this process is to treat the waste water generated in the laundry and staff showers at nuclear facilities. To protect themselves from radiation, staff working within restricted areas use equipment such as safety suits, boots, goggles, masks, gloves, etc. This equipment can be washed for decontamination and later use. The laundry waste water can contain radioactive particles, especially during stoppages of nuclear plants when maintenance work is carried out.

This innovative process enables the water to be treated in such a way that the most part can be reused for washing, thereby saving on water and minimizing its discharge. It involves two treatment lines, that enter into operation depending on whether or not radioactive substances are present. The process was developed with the aim of minimizing the amount of low and intermediate level waste (LILW) produced, thereby guaranteeing the quality and efficiency of the washing.

TECHNICAL CHARACTERISTICS

- Volume reduction factor: over 100 times.
- Radioactivity decontamination factor: practically total elimination.
- Maximum reduction in low and intermediate level waste (LILW).

PROCESS

This process uses ozone during washing with the triple aim of minimizing the dispensing of chemical products (detergent, whiteners, softeners, etc.), reducing the contaminant load to the maximum due to its high oxidation potential, and guaranteeing a high-quality wash given that the protection material would also come out disinfected. In the case of no radioactivity appearing in the effluent, the treatment process is simple and efficient. In the case of detecting values exceeding 0.02 mSv/year in the effluent, the radioactive species will first be ionized and then held in a mixed bed ion exchange. The reload effluent of the anionic and cationic resins is concentrated in a vacuum evaporator and subsequently a crystallizer, with the aim of reducing the amount of solid waste that must be managed as low and intermediate level waste (LILW) to a maximum.

Gases dissolved in the effluent which contain descendants of uranium such as radon-222 or activated gases like tritium, are sent to the atmosphere after previously passing through a decay tank that guarantees the loss of radioactivity.

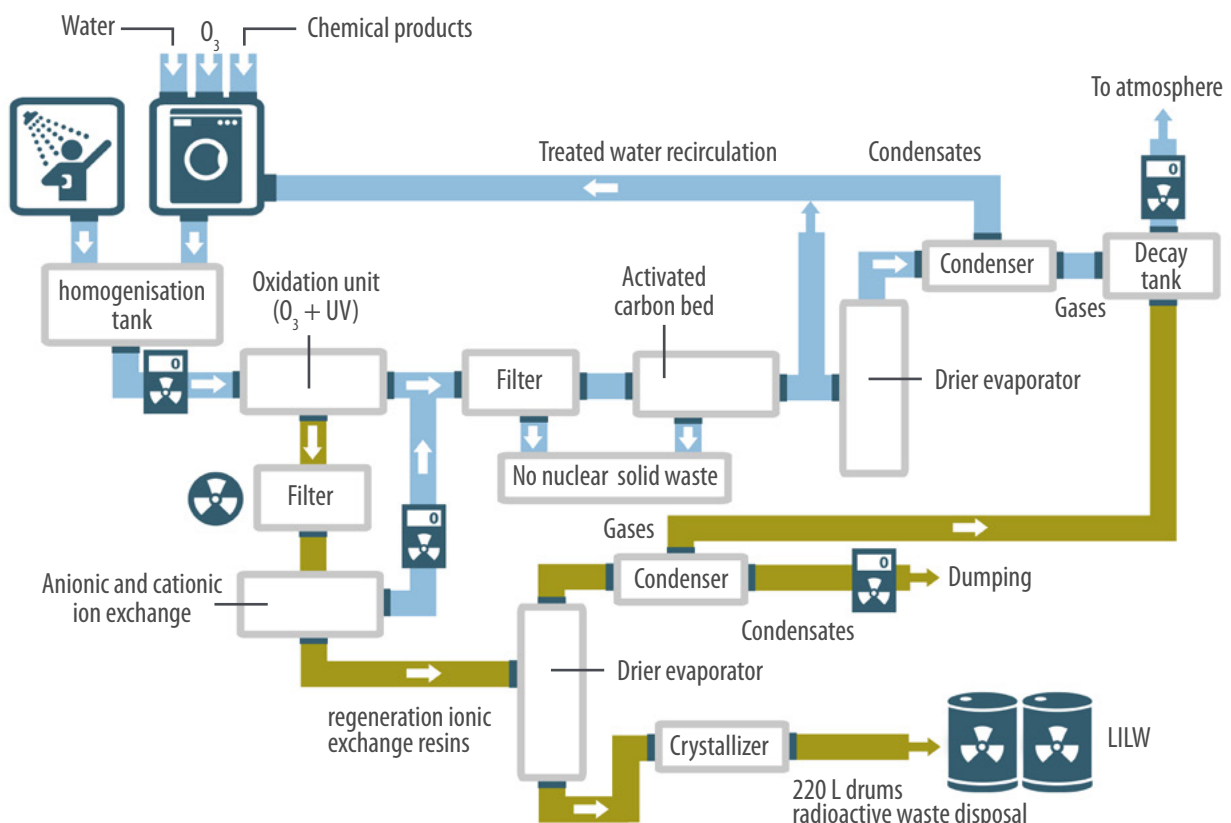
APPLICATIONS

The **NUCLEANTECH® Laundry** process has been specially designed for nuclear plants, although it can also be of great use at uranium enrichment and nuclear fuel plants, as well as facilities involved in medicine, metallurgy, research, etc. working with radioactive isotopes.

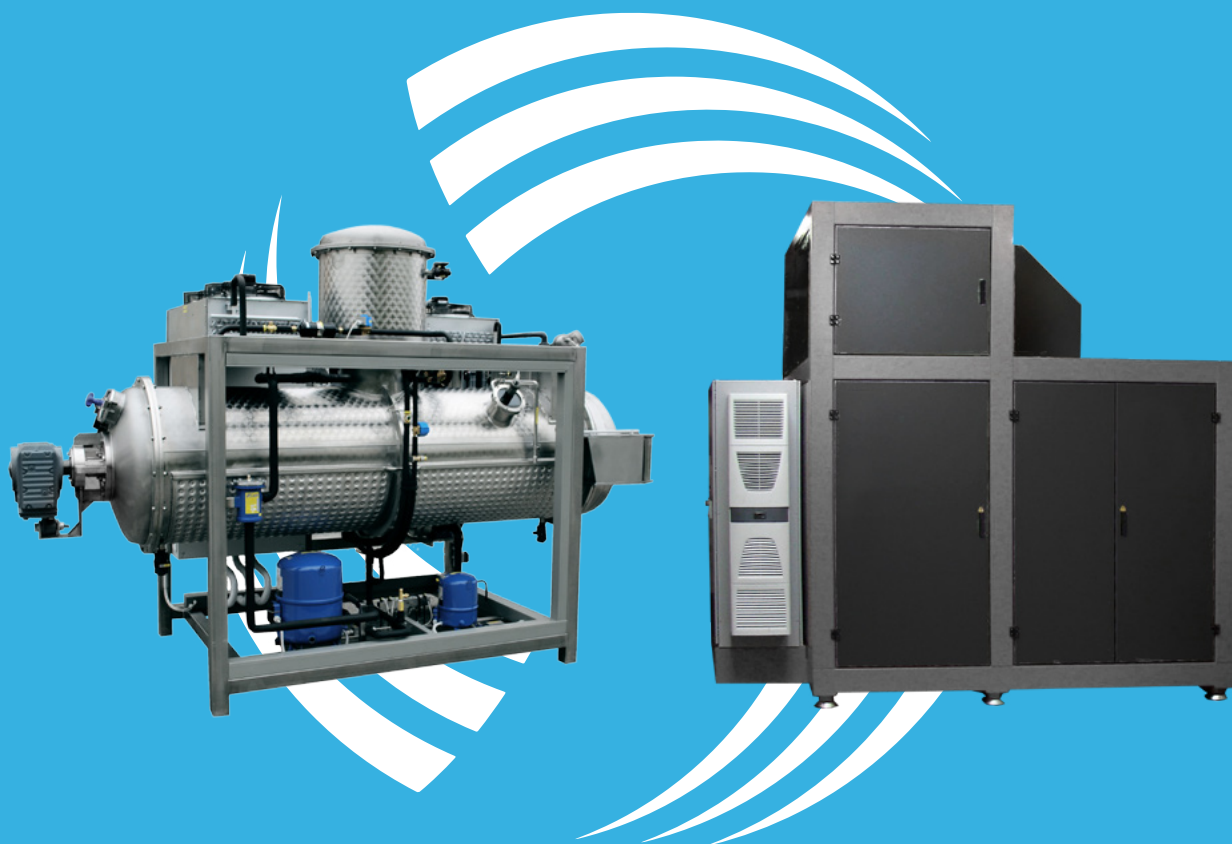
ADVANTAGES

- High quality and efficiency of washing.
- Waste water reuse with the corresponding reduction in consumption and discharge.
- High reduction in the quantity of produced waste, especially low and intermediate level waste (LILW).
- Exhaustive control of radiation throughout the entire process.
- Flexibility in the treatment regarding fluctuation in quantity, radioactivity and effluent contaminant load.
- Strict compliance with the strictest standards.

PROCESS DIAGRAM



NUCLEANTECH® UF₆



CONCEPT

The objective of this process is to treat waste water produced by washing equipment used in the synthesis, manipulation and transport of uranium hexafluoride (UF₆) at nuclear fuel preparation facilities. This water contains radioactive particles of low and medium activity and should be treated accordingly. The process is characterized by obtaining high quality water that can be reused in washes and extreme minimization of completely dry solid waste, which must be managed as low and intermediate level waste (LILW). This means that cost saving compared to more conventional processes is quite significant.

TECHNICAL CHARACTERISTICS

- Water extraction: around 80-95%.
- Strong volume reduction to obtain dry solids.
- Maximum reduction in low and intermediate level waste (LILW).
- Possibility of implementation of a zero-discharge system.

PROCESS

In the uranium enrichment process, so that ^{235}U is found in the suitable proportion in nuclear fuel, two uranium isotopes must be separated. This is achieved in the hydrofluorination of UO_2 to achieve UF_6 . The uranium hexafluoride enables the separation of the two isotopes through gaseous diffusion or ultrafiltration. Washing of equipment used in the synthesis, manipulation and transport of UF_6 , generates waste water containing remains of uranium, and as a result also transuranic elements derived from natural decomposition. This means that the water contains low and medium level radioactive particles.

The **NUCLEANTECH® UF_6** process enables effluent suitable for reuse to be obtained, by using an evaporator-dryer that operates under vacuum conditions. The solid waste generates is practically dry, and hence its volume is reduced to a maximum, and must be managed according to the nature of low and intermediate level solid waste (LILW). The large quantity of condensed water is reused, both to minimize its consumption and reduce or even eliminate the discharge of liquids in the process.

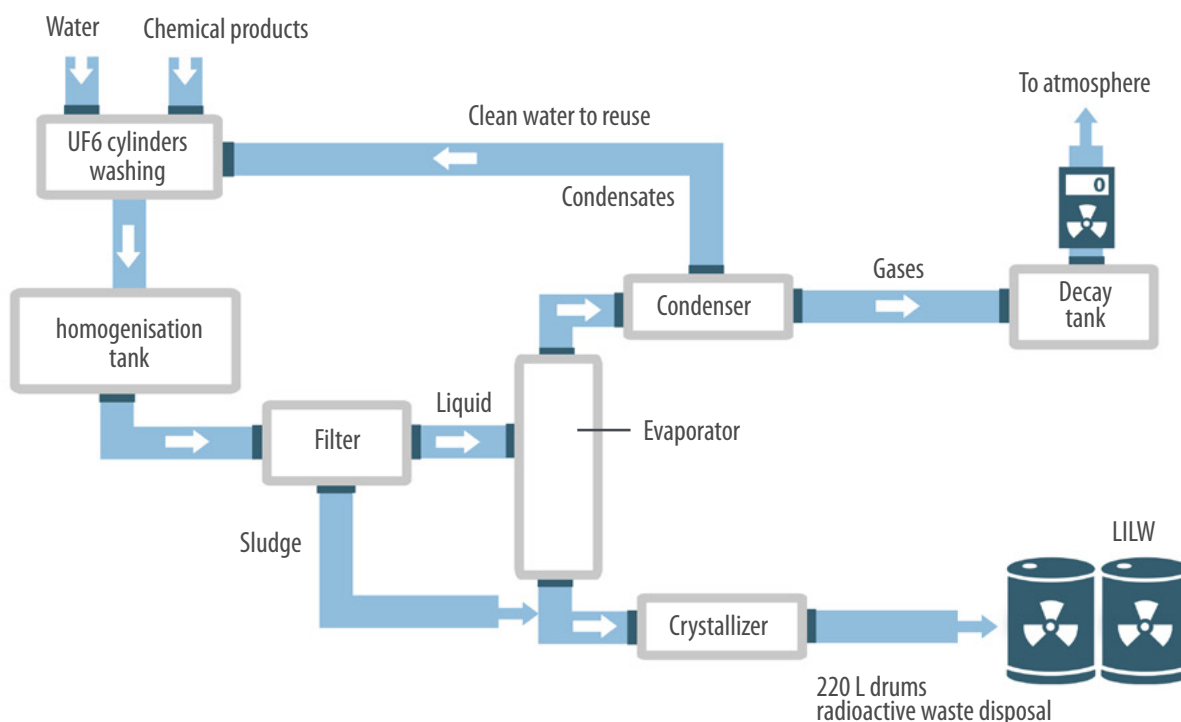
APPLICATIONS

The **NUCLEANTECH® UF_6** process enables the treatment of waste water generated during the washing of equipment and facilities that manipulate raw material and radioactive products. Although most of cases are nuclear fuel preparation plants, given the versatility of the process, it can also be used and applied to nuclear plants, research laboratories, etc.

ADVANTAGES

- Complete minimization of solid waste of low and intermediate level solid waste (LILW).
- Minimization of water consumption and zero liquid effluent discharge.
- Exhaustive control of radiation throughout the entire process.
- Strict compliance with the strictest standards.

PROCESS DIAGRAM



NUCLEANTECH® H₃BO₃



CONCEPT

The objective of this product is to treat waste water produced in the regeneration of ion exchange resins in the treatment of primary circuit refrigerant of PWR reactors. The effluent from the regeneration of these resins contains all of the previously retained anions and cations, the majority of which are radioactive isotopes from the activation of atoms of irradiated structural materials by neutron flow (⁶⁰Co, ¹²⁹I, ¹³¹I, ⁹⁰Sr, ⁵⁵Mn, ⁵⁹Fe, ¹³⁷Cs, ¹³⁴Cs, ⁵¹Cr, etc.). This water can contain a significant amount of radioactive substances, so its decontamination must be carried out in an effective, controlled and safe manner. Furthermore, and also very importantly, this process also enables the recovery of the boron used in the reactor as a moderator of neutron flow, which is nuclear grade boron.

TECHNICAL CHARACTERISTICS

- Complete decontamination of the liquid effluent.
- Minimization of solid waste of low and intermediate level (LILW).
- Recover of nuclear grade boron from the primary refrigeration circuit.
- Exhaustive control of radiation throughout the entire process.
- Strict compliance with the strictest standards

PROCESS

The process is based on the separation and crystallization of boric acid solution in water from primary circuit refrigerant or sodium borate when it is neutralized with caustic soda. This effluent is concentrated using an evaporator & crystallizer obtaining dry crystals.

Furthermore, this process enables the recovery of the boric acid when possible.

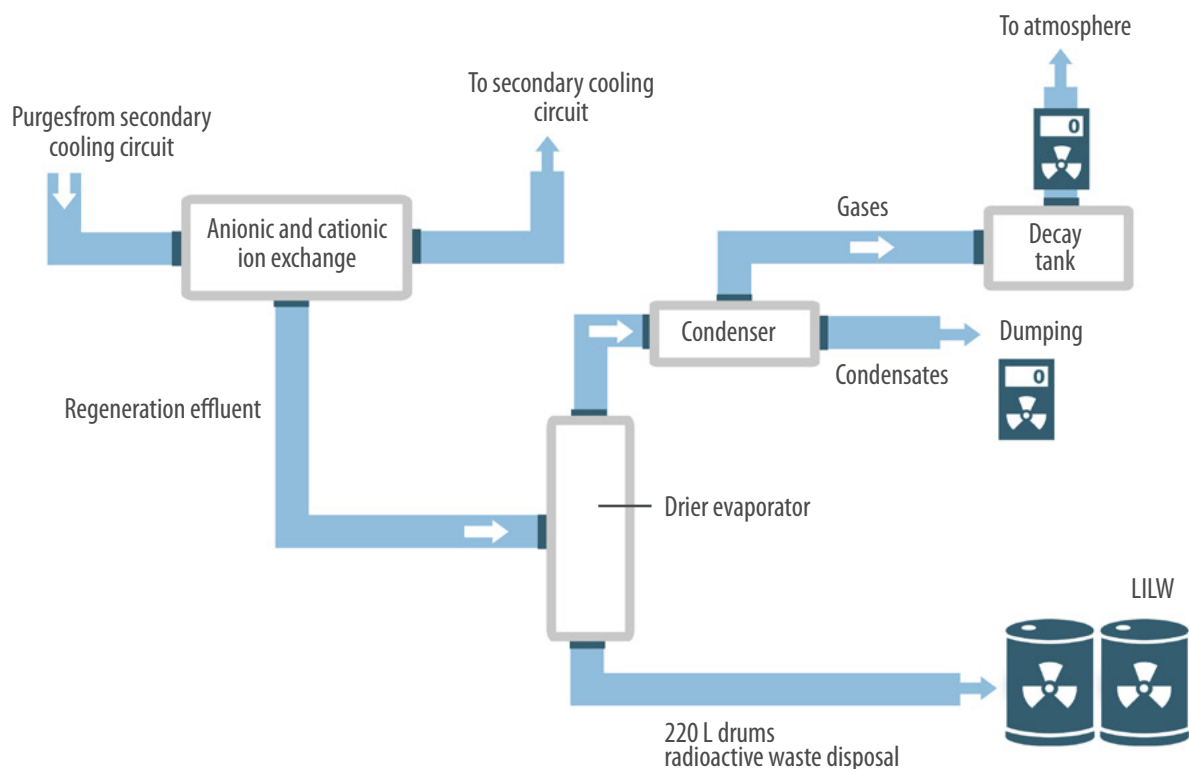
APPLICATIONS

The **NUCLEANTECH® H_3BO_3** process has been developed for the decontamination of effluent generated in the regeneration of ion exchange resins of the treatment of primary circuit refrigerant of PWR reactors. Furthermore, with small technical adaptation, the same process would be apt for the recovery of the boric acid present in the primary circuit refrigerant, obtaining nuclear grade boron.

ADVANTAGES

- Complete decontamination of the liquid effluent.
- Recovery of nuclear grade boron from the primary circuit.
- Minimization of solid waste of low and intermediate level (LILW).
- Significant reduction in financial operating costs.

PROCESS DIAGRAM



NUCLEANTECH®

NUCLEAR WASTE DISPOSAL REDUCTION (NWDR)



CONCEPT

The objective of this process is to minimize the solid waste generated at nuclear facilities, be it fuel preparation plants or nuclear plants. A series of products are used at these facilities (gloves, masks, clothes, pallet wood, plastics, etc.) which once used must be removed, and given the strict standards regulating the sector and the fact that they can carry particles of low and medium activity, their management as nuclear waste is very expensive.

This innovative process was designed to reduce this solid waste to the maximum, so that the solid waste that is finally managed as nuclear waste is a very small proportion of the initial volume.

Unlike the typical incineration process, where permitted by standards, this process can be carried out on site.

TECHNICAL CHARACTERISTICS

- Process based on pyrolysis and catalytic thermal oxidation to guarantee the maximum effectiveness of the treatment .
- Reduction of the original volume of the solid waste of low and intermediate level (LILW) by around 90%.
- Strict compliance with the most demanding standards.

PROCESS

The process is characterized by the treatment of low activity solid waste generated at nuclear facilities (protection equipment, clothes, footwear, plastics, pallet wood, etc.) through a pyrolysis process, in the absence of oxygen, so that a small volume solid fraction is obtained (char), a liquid stream and a gas fraction (syngas). The liquid stream once treated to be concentrated and is stabilized in solid medium. The syngas, which is a mixture of hydrogen, carbon monoxide, methane, short-chain hydrocarbons, benzene, etc., are converted to carbon dioxide and water by means of a catalytic thermal oxidation process. In this manner, the initial solid waste is converted into a minute fraction of the individual waste, as well as a gas stream that can be released to the atmosphere with total ease after passing the strictest of environmental controls.

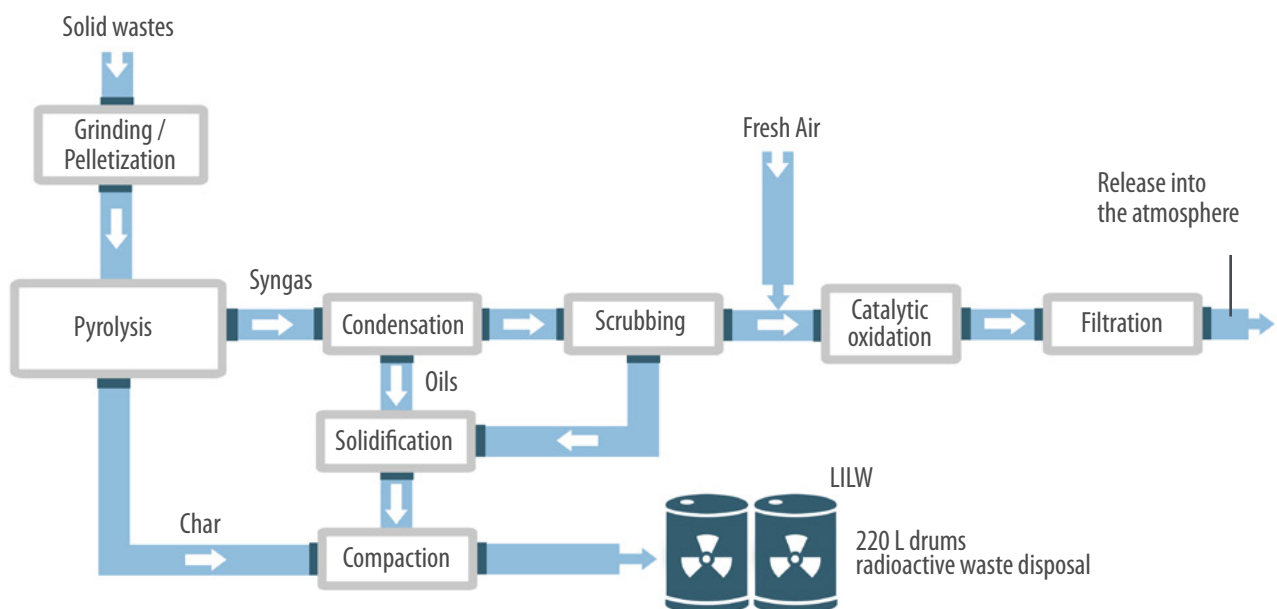
APPLICATIONS

The **NUCLEANTECH® NWDR** applies to all facilities that manipulate radioactive species and generate solid waste, despite the fact that their radioactivity is very low.

ADVANTAGES

- Ash which is potentially very contaminating is not generated.
- Dioxins and furans avoided.
- On-site process, without the need to transport the waste to be treated.
- As oxygen is not used, new radioactive species are not generated, such as ^{14}CO or $^{14}\text{CO}_2$.
- Significant reduction in the management cost of solid waste produced.
- Relevant reduction in environmental impact compared to conventional management of solid waste.

PROCESS DIAGRAM





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