2022
case study

UCW ONCO LINE

PHARMA
DIVISION

cGMP
SOLUTION

LAST®
TECHNOLOGY

The Customer Requirement

DESIGNING A PHARMACEUTICAL WASHING EQUIPMENT MODEL WITH A CONTAINMENT SYSTEM FOR CYTOTOXIC DRUGS

An Algerian pharmaceutical company was looking for a washing equipment model that could handle devices used to manufacture cancer drugs. In other words, devices at a high risk of chemical and biological contamination.

In recent years, the use of antiblastic drugs has significantly increased. In fact, advances in cancer research have led to the launch of new, increasingly focused modules on the market, which can also be used to treat non-oncological pathologies, such as some autoimmune and neurological diseases.

However, this type of medicine requires special and ultra-careful precautions, as they are highly toxic. Many substances used to prepare antiblastic chemotherapy drugs are classified by the International Agency for Research on Cancer (IARC) as carcinogenic to humans or suspected of such.

The operators who handle these substances are therefore professionally exposed. The substances can be absorbed: by inhalation (powders, aerosols, vapours), with consequently irritated mucous membranes; via the skin, by coming into direct contact with the drug, which can cause hyperpigmentation, eczema and even actual necrosis of the cutaneous and subcutaneous soft tissues; by the digestive route, causing damage to the oropharyngeal mucous membranes; and can ultimately cause conjunctival irritation, such as excessive tearing and photophobia, with varying degrees of damage to the corneal epithelium.

To date, there are no systems that permit such safe washing and handling operations on the market. The sector is currently limited to only handling inside insulators as the washing phases are performed manually inside automatic machines after external handling, with a consequent high risk of contamination.
The client, therefore, was in search of solutions designed to improve these work and handling phases, whilst guaranteeing greater safety for all operators.

Preliminary points to consider before designing the right machine solution

As usual, the engineering team took into consideration the fact that they would have to design a washing equipment model for large containers, such as BINS, which could also safely and efficiently wash previously bagged machine parts for their optimally safe transfer to the washing equipment model.

To achieve this, the team started with some mandatory points without which the machine could not be designed:

- It had to have pharmaceutical industry-compliant design characteristics and conform to the EC, EudraLex and FDA directives, in addition to the cGMP good manufacturing standards.
- The loaded solutions had to be flexible and parameterised in order to allow the operator to select the correct settings depending on the load being washed.
- The load had to be fully washed in its various forms, especially the hollow one.
- The internal and external surfaces had to be accessible to make cleaning and removing dirt easier, and the technical compartments had to facilitate maintenance operations.
- The machine-controlling and automating user panel would have to have intuitive and simple graphics to limit the operator to the specific operations

In addition to having all the above-mentioned characteristics, the machine would need to be suitable for:

- introducing large bins
- handling “contaminated” components inside the machine
- manually washing and spraying components
- extracting the plastic casings containing contaminated machine parts in the safest way possible.

Complies with CE regulation

Easy and intuitive

Maximum security

Flexibility by load type

Process phases analyses

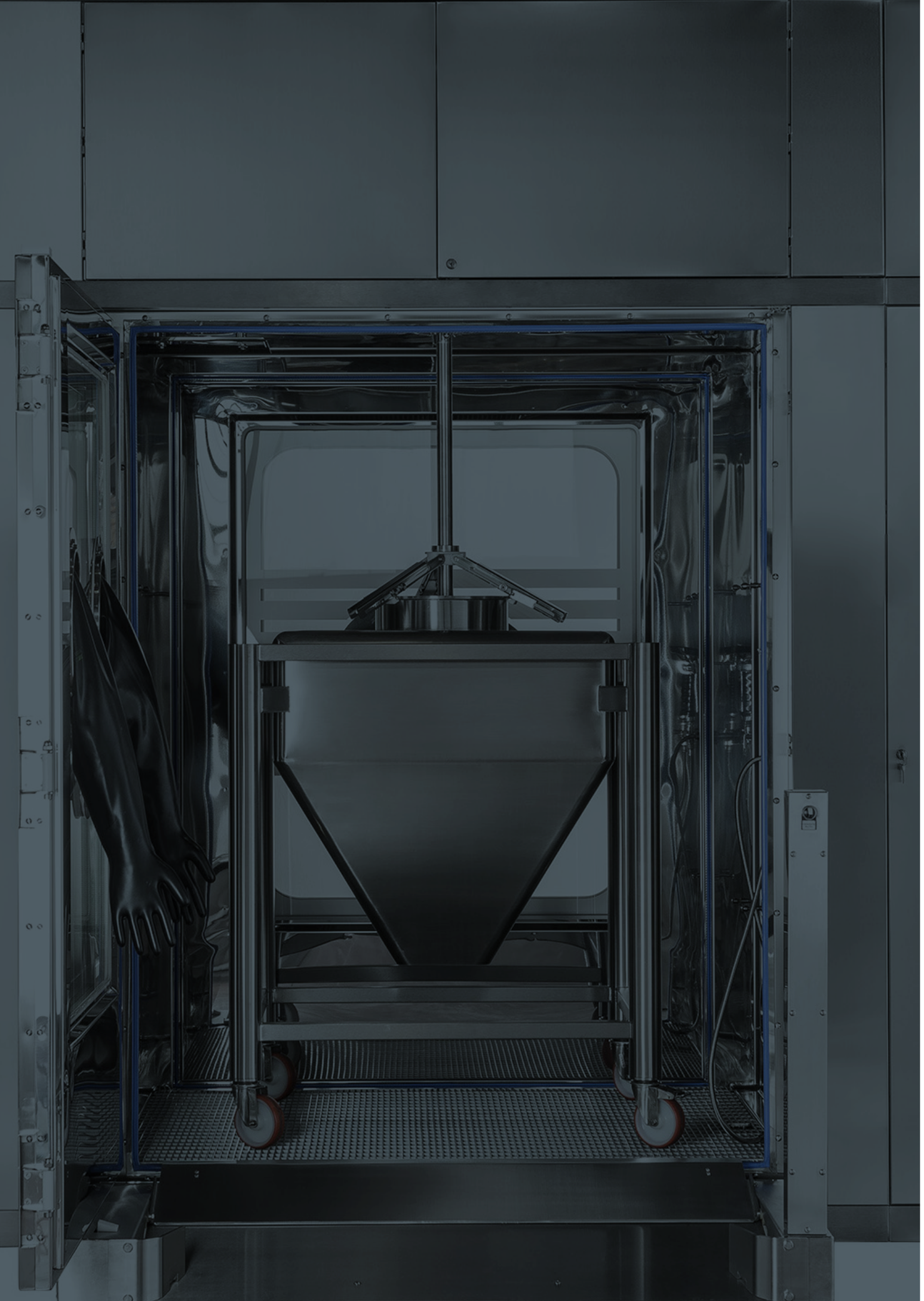
Before designing the machine and bearing the above-listed preparatory points in mind, the team focused on the machine's functional sequences by envisaging various scenarios.

The process is generally characterised by an initial pre-washing phase which removes surface dirt by means of mechanically-acting water.
Next is the actual washing phase. In addition to the mechanical action of the pressurised hot water, detergents and chemical additives are diluted in this phase to completely remove any dirt on the treated surfaces.

At the end of this phase, a rinse is performed to remove all traces of detergents, before proceeding to dry the parts.

The machine in question must handle both large bins - used during the normal production process - and small parts allocated in special trolleys. For this reason, the team decided to fit a nozzle that would provide a 360-degree wash inside the bin, and hydraulic connections to connect the internal trolleys.

As already mentioned above, the load (machine components) is supplied packed in special bags to prevent the operator from coming into direct contact with the parts and thus, the risk of contamination. In-depth research was therefore carried out regarding the removal of such bags and handling the contaminated load to allow it to be washed safely.



The project

Starting with the load to be washed, two specifically designed gloves - widely used in insulators - are placed on the washing equipment's door. Consequently, an operational sequence was created as follows:

- The contaminated load is placed in bags which are, in turn, placed on the washing trolley.
- The trolley is inserted into the machine and connected to the washing equipment's water supply.
- The washing equipment's door is closed and the bags are removed via the special gloves.
- The contaminated bags are disposed of via a medical waste door, connected to a collection bag.
- Once the disposal operations have been completed, the bag containing the "contaminated" items is heat-sealed and removed from the door.
- The operator then manually sprays the load, using a washing lance, to remove any surface dirt.
- The solution is selected and the automatic washing cycle starts.

In this way, the operator will never come into contact with the contaminated components and bags.

In pharmaceutical practice as standard, a validated washing phase comprises the following steps: pre-washing, washing/ disinfecting, rinsing, drying with hot air and cooling.

5 distinct sub-phases can be distinguished for each washing phase:

- **Filling up with water**
- **Heating the water**
- **Water recirculation**
- **Cleaning and Disinfection**
- **Draining**

In pharmaceutical settings, the machine can be typically connected to three different types of water:

- **Softened cold water**
- **Softened hot water**
- **Demineralised, purified or deionised water**

Depending on the type of cycle, it is possible to use from one to three of the aforementioned utilities, suitably mixed with up to four different types of detergents.
To increase the fluid's cleaning action, different doses are sprayed onto the load; these are selected from time to time by the operator, depending on the load being treated.

These detergent mixing and diluting operations take place in an accumulation tank which prepares the cleaning mixture.

The temperature of the water + detergent mixture is continuously monitored. The machine intervenes by activating/deactivating the heating elements or heat exchangers placed inside the container.

The penultimate stage, the drying phase, is obtained by introducing filtered compressed air to remove any water residue inside the pipes and break down any drops inside the chamber. HEPA-filtered hot air is subsequently introduced in large quantities at a maximum temperature of 130°C. The air is drawn from the environment and subjected to a heat exchange by means of several heating elements or a steam heat exchanger.
It will take a maximum of 30 minutes for the load to be fully dried and returned to a low level of relative humidity.

The cooling phase then takes place by introducing air into the chamber at room temperature, which is also suitably filtered so as not to compromise the previous operations.

For the entire process, the chamber's internal environment maintains a slight overpressure (up to a maximum of relative 250 Pa), in order to eliminate and dispel any possibility of contamination from the waste products and/or external environment.

UCW 4000 ONCO line

The chamber is made of AISI 316L steel, like all the other parts that come into contact with the process fluids, and boasts a rectangular cross-section, in addition to a 4000-litre total capacity.

A trapezoidal cross-section collection tank is located at the bottom of the chamber which conveys the sprayed water in order for it to be sucked up and recirculated by means of a hygienic centrifugal pump.

Two doors interface respectively on two distinct environments with a different degree of cleanliness.
The loading door is equipped with a pair of neoprene gloves - typically used in insulators - which are affixed to the tempered glass by means of two flanges that guarantee a perfect hermetic seal. Between the two flanges of the gloves, there is space for contaminated bag-unloading door, which is also affixed to the tempered glass.

A system of pneumatic extraction platforms facilitates the bin and washing trolley-loading operations.

10 washing heads are located throughout the chamber to cover its entire surface and ensure that the load is fully exposed to the washing fluid.

There is also an automatic cylinder with a rotating head at the end which is used to wash the interior of the bins, in addition to a connection that connects the machine part-dedicated loading trolley.
The trolley is also equipped with rotating washing nozzles to treat hollow-bodied surfaces.

The technical compartment can be accessed via the door on the front of the machine.

The generated vapours are sucked in and conveyed to a chimney that connects the chamber to the installation site's exhaust system.

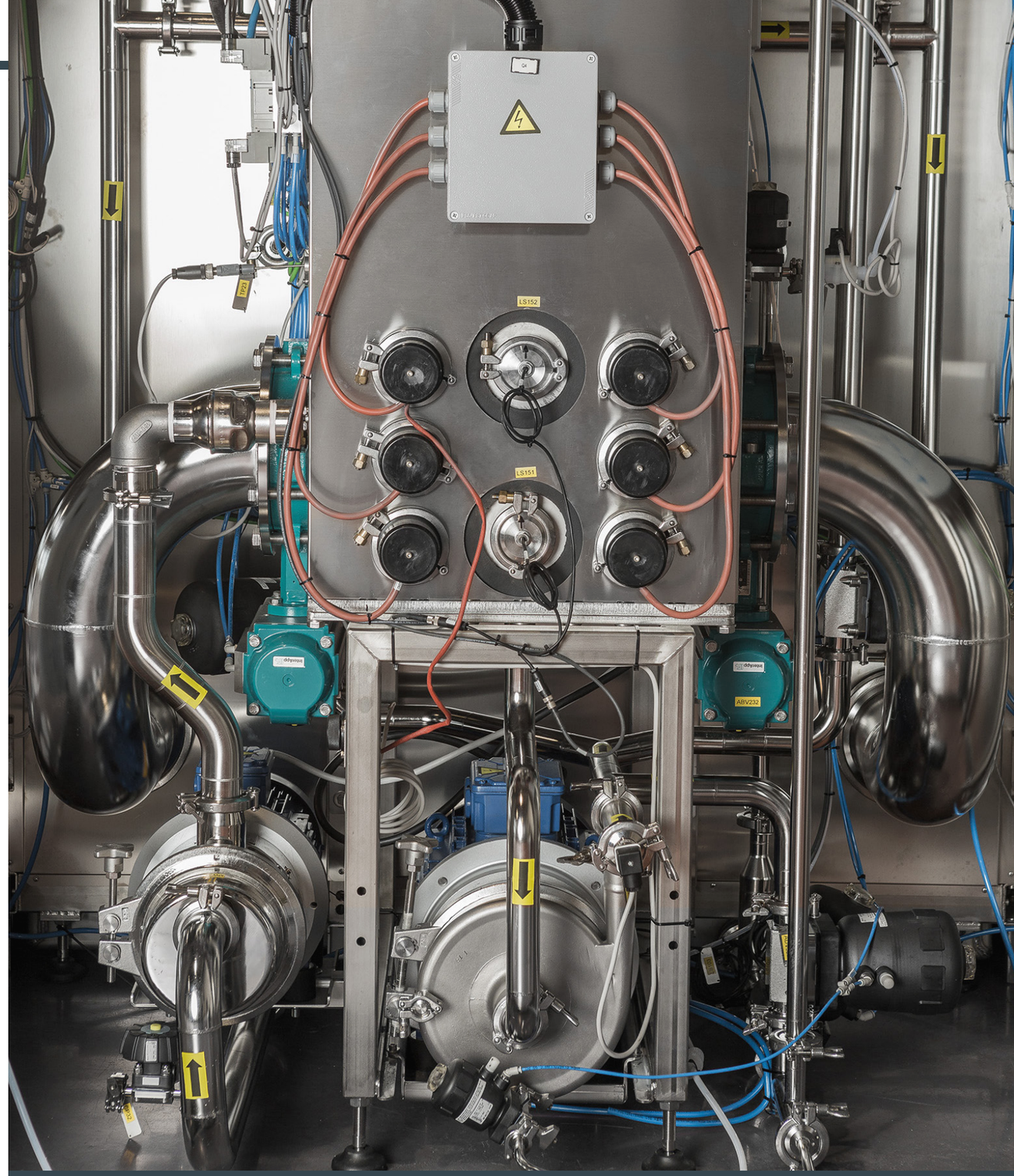
When the cooling phase has finished, an electric-pneumatic interlocking system will only allow the treated product-unloading door to be opened.

The unloading door is enabled in the event of a successful process.

The loading door, on the other hand, is enabled if any alarm has occurred that could compromise the cycle's end result.

This logic allows only one door to be controlled at a time, by not allowing the two environments loading (dirty) and unloading (clean) to communicate with one another.

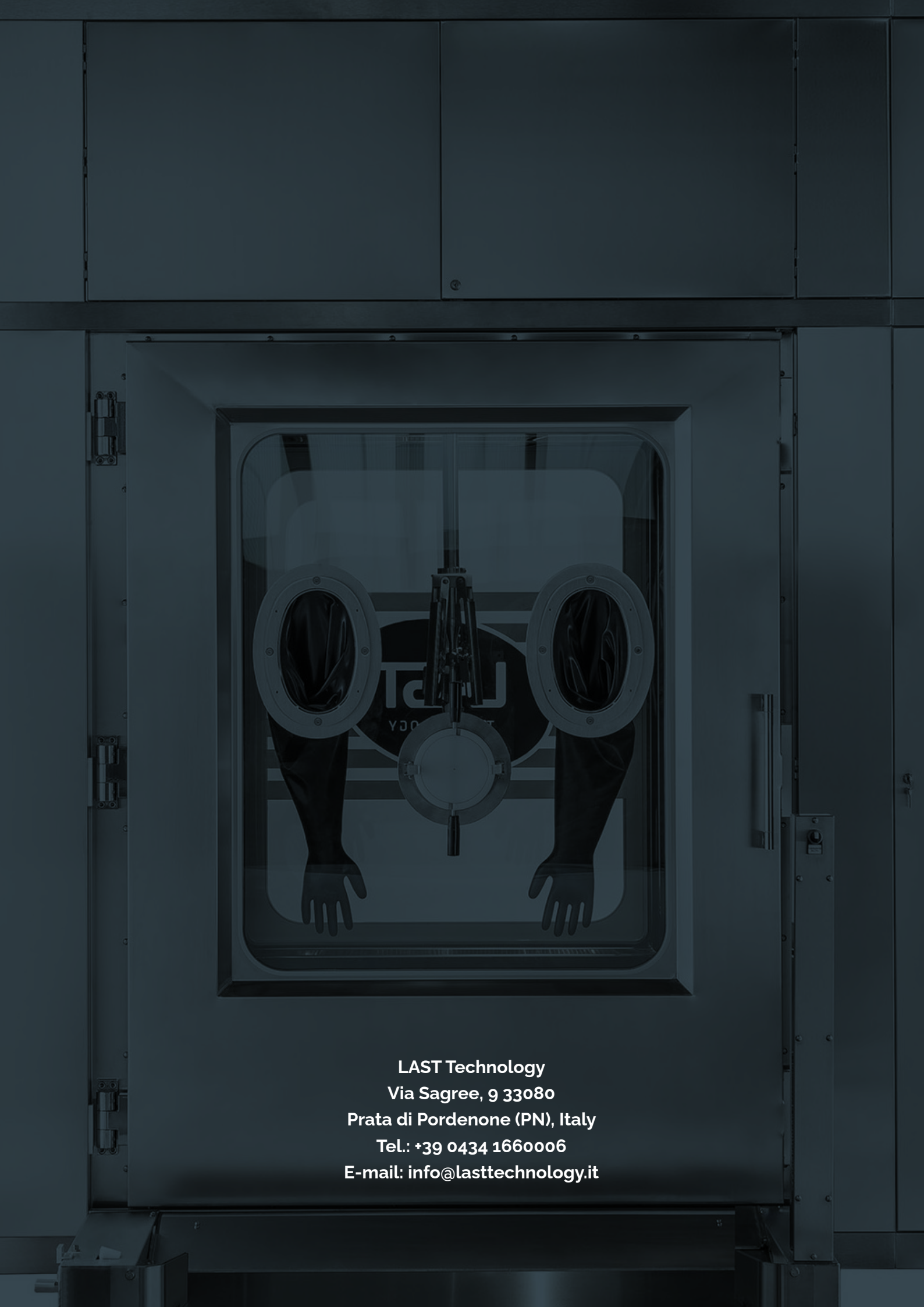
The machine is automated by means of a programmable controller (PLC) interfaced to a monitoring system with an industrial PC and operator panel placed on the loading and unloading side, respectively. A VPN connection is provided between the machine and the LAST Technology remote assistance centre.



SOLIDS AND SEMI-SOLIDS

WATER + DETERGENT + AIR

20°C - 120°C



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