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Opening photo: Taweelah Aluminium Extrusion Company LLC is an integral part of the Economic Vision 2030 of Abu Dhabi.



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TALEX: Excellence in Extrusion and Finishing Technology for High-Tech Hard Aluminium Alloy Profiles

Alessia Venturi **ipcm**[®]

Abu Dhabi is a thriving global business centre on the Arabian Gulf coast. With the government investing billions of dollars in the diversification of its economy and infrastructure, the capital city of the United Arab Emirates is rapidly turning into one of the most important economic, industrial and commercial centres in the world.

The Khalifa Industrial Zone Abu Dhabi (KIZAD) is an integral part of the Economic Vision 2030 of the Emirate, an ambitious multi-

year economic transformation program to be completed by 2030 to further develop all non-hydrocarbon activities. Aluminium, iron, steel, glass, metal, plastics and petrochemical are just some of the heavy industry fields selected to stimulate growth in the manufacturing sector and create new job opportunities for the citizens of the UAE.

The strategic location of this industrial area connecting the East with the West, coupled with multimodal transport infrastructure

(sea, air, road and rail), facilitates the business activities by providing easy and efficient access to more than 4.5 billion consumers across four time zones. In the middle of KIZAD (Fig. 1), there is Taweelah Aluminium Extrusion Company LLC (TALEX, ref. Opening photo), the most advanced aluminium extrusion and finishing plant in the Middle East and the 2016 winner of the Gulf Cooperation Council (GCC) award in the category Industrial Project of the Year. TALEX is a joint venture between SENAAT, the Abu Dhabi Holding Company, and Gulf Extrusion, a company of the Al Ghurair Group, with extensive manufacturing expertise and a global sales network.

A fully vertically integrated production process

TALEX designs and produces high quality aluminium profiles. No other material features the same versatility and environmental compatibility characteristics, and TALEX takes advantage of these unique qualities to design innovative components and solutions starting from the selection of the most suitable aluminium alloy for each application. TALEX' production process starts from liquid primary molten metal delivered by EGA to its own cast house converting to precision machined aluminium products in it is fully vertically integrated premises. Its plant plot area, covering 200,000 m², 72,000 of which are covered, and built on a greenfield site in less than five years with a total investment of over 240 million dollars, provides to its prestigious customers casting, extrusion, surface treatment and fabricated

aluminium products around the world. TALEX' Chairman Ali Murshed Al Marar has stated that, "As part of the effort to diversify the economy of the emirate of Abu Dhabi, TALEX is the result of the amalgamation of key strengths available in the UAE as well as the drive of its two leading shareholders.

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Figure 1: KIZAD is the commercial, logistic and industrial hub of Abu Dhabi, the capital city of the United Arab Emirates.

TALEX in numbers

- Investment:** 240 million \$
- Factory Size:** 200,000 m²
- Extrusion capacity:** 50k MT/year
- Powder Coating Capacity:** 13k MT/year
- Anodizing capacity:** 14k ton/year
- Cast house capacity:** 45k ton/year
- Natural Gas consumption:** 1.8_{MM} scf/day
- Electricity consumption:** 17.1_{MW} connected load
- Process water:** 1,200 m³/day

The presence of a unique aluminium smelter concentration, state of the art port and logistics facilities and a well-established aluminium extrusion industry have enabled us to establish the ultimate extrusion plant that increases the region's industrial capacity and capabilities to unprecedented levels.

Our goal is to establish Abu Dhabi and the UAE as one of the world's leading aluminium extrusions centres of excellence. TALEX will enable us to exploit new possibilities in the upcoming architectural landscape and will also be an enabler for the automotive and aerospace industries as they seek to

achieve the demanding technological leap and associated weight reduction that these industries must attain in the coming years. Across the world, innovation cycles are shrinking and companies that do not respond to these changes risk being left behind. We have spared no effort in equipping our plant with the finest technology available. We have maximized our level of automation so that our objective, which is to deliver a complete

solution to our customers and grow with their needs, can be achieved.” For TALEX, choosing the best available technology has meant to rely on a pool of Italian suppliers of surface treatment equipment. Trasmetal (Milan) designed and installed its horizontal powder coating system (Fig. 2), one of the largest, versatile and technologically advanced in the world. This integrates a power & free conveyor (Fig. 3) with a capacity of 1,000 kg (including bars) per



Figure 2: The large size of the horizontal powder coating plant supplied to TALEX by Trasmetal (Milan, Italy).

rack, designed by Futura Convogliatori Aerei (Robecco Pavese, Pavia). Cisart (Coccaglio, Brescia) provided the two anodising systems, a “short” one for bars up to 7 metres and a “long” one for bars up to 14 metres (Fig. 4). CIE Srl (San Zenone al Lambro, Milan) developed an innovative treatment system for the coating and anodising processes’ waste water, which will be implemented in three phases, about two years apart; it will enable the company to achieve a closed-loop operation and recover 95% of the water used (Fig. 5), a key factor in competitiveness and environmental compliance given the region’s water scarcity and the severity of the government’s drainage limits.

“TALEX’s job is to select the most suitable alloy for the costumers needs. It also committed to a continuous improvement process. Aluminium is highly corrosion resistant, it is lighter than steel and, when using the right alloy, it ensures excellent mechanical properties. TALEX receives primary aluminium molten metal at 950 °C from the neighbouring smelter EGA, and during casting and alloying process it mixes the primary metal with TALEX own scrap and other alloying elements to cast TALEX’s exclusive alloys. These hard alloys, especially of aluminium and magnesium, have higher mechanical properties and corrosion resistance compare to the commercial ones.”

Hard aluminium alloys for high-tech profiles

“TALEX offers different products and services to a wide variety of industrial sectors, supporting their projects to improve the performance, efficiency and competitiveness of their products and structures,” TALEX’ General Manager Stylianos Tsoktouridis (Fig. 6) says while welcoming us at the company headquarters, located along the highway linking Dubai to Abu Dhabi. “TALEX is an extrusion company that provides to its prestigious customers innovative aluminium alloy solutions to further develop and improve their products. Our job is to select the most suitable alloy for their needs. We are also committed to a continuous improvement process.

Aluminium is highly corrosion resistant, it is lighter than steel and, when using the right alloy, it ensures excellent mechanical properties. We receive primary aluminium molten metal at 950 °C from our neighbouring smelter EGA, and during casting and alloying process we mix the primary metal with TALEX own scrap and other alloying elements to cast TALEX's exclusive alloys. These hard alloys, especially of aluminium and magnesium, have higher mechanical properties and corrosion resistance compare to the commercial ones. For instance, we are currently performing some tests for an automotive tier 1 manufacturer to select the most suitable aluminium alloy for replacing steel profiles. The weldability tests' results have been excellent, and we are now carrying out the fatigue tests. If all the tests will be positive, our customer will

“TALEX owns an impressive number of plants and systems and the layout has been developed to ensure that the production flow is perfectly optimised. For example, all the extrusion lines are oriented in one direction and followed by the logistics area, so that the profiles are safely and cleanly handled and transferred to the coating and anodising plant. Finally, the unloading stations of the two surface treatment systems have been designed to facilitate packaging and shipping.”

be able to reduce the weight of its trailers by 2 tonnes, resulting in greater sustainability and greater profitability, since it will be possible to increase the load on each trailer and reduce the number of trips. Our goal therefore is not only to extrude for architectural building systems, which anyway remains part of our business, but also to supply niche and high-added value products for industrial use.”

Impressive equipment

“This project officially started in 2011, but the construction of the factory only began in 2014: it took us almost three years to choose the best available technologies needed for this ambitious extrusion, surface treatment and manufacturing plant. We have been supported by a European consulting firm in this long journey,” says Sajid Hussain, the Operation

Manager of TALEX (Fig. 7). “The project was completed in the first quarter of 2017, with the exception of two buildings that will be finished during Phase 2. In full operation, the factory will have about 380 employees. It owns an impressive number of plants and systems and the layout has been developed to ensure that the production flow is perfectly optimised. For example, all the

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Figure 3: The power & free conveyor designed and built by Futura Convogliatori Aerei has a net load capacity of 500 kg.

extrusion lines are oriented in one direction and followed by the logistics area, so that the profiles are safely and cleanly handled and transferred to the coating and anodising plant. Finally, the unloading stations of the two surface treatment systems have been designed to facilitate packaging and shipping. "TALEX also has an advanced foundry with an annual capacity of 45,000 tonnes of billets with five different diameters, 7", 8", 9", 10", and 11", with the possibility of increasing the number of diameters available in the near future. After quality control in an ultrasonic station, the billets are processed in a continuous homogenisation and cascade air cooling line. The cutting and packaging line supplies billets with a maximum length of 7 metres. The extruded profiles are available with three different surface finishes: mill finish, anodized or powder coated aluminium. The two extrusion presses, with a capacity of 25 and 35 tonnes, can extrude profiles with any kind of shape, even the most complex ones and aluminium alloy. The extruded profiles are primarily intended for the architecture, automotive, transportation, marine, defence and general engineering applications of Australian, USA, Canada,

European, Indian, and of course the Middle East markets."

As for powder coating, TALEX has ordered Trasmetal a cutting-edge horizontal plant able to treat up to 8.2 metres long profiles meeting the Qualicoat standards (Fig. 8) and achieve a

“As for powder coating, TALEX has ordered Trasmetal a cutting-edge horizontal plant able to treat up to 8.2 metres long profiles meeting the Qualicoat standards and achieve a productivity of up to 14,000 tonnes/year, corresponding to about 5 million square metres of aluminium surface. There are two anodising lines, both fully meeting the Qualanod standards: a “short” one for profiles up to 7.2 metres and a “long” one for profiles up to 14.2 metres. Both surface finishing areas are equipped with a dedicated lab that constantly monitors the quality of processes according to the European regulations.”



Figure 4: Cisar provided two anodising lines, one for profiles up to 7.2 metres and one for profiles up to 14.2 metres.



Figure 5: A bird's eye view of the waste water treatment system developed by CIE Srl. In the foreground, the transfer pit area and the buffer area.

productivity of up to 14,000 tonnes/year, corresponding to about 5 million square metres of aluminium surface. There are two anodising lines, both fully meeting the Qualanod standards: a “short” one for profiles up to 7.2 metres (Fig. 9) and a “long” one for profiles up to 14.2 metres. Both surface finishing areas



Figure 6: Stylianos Tsoktouridis, the General Manager of TALEX.

are equipped with a dedicated lab that constantly monitors the quality of processes according to the European regulations. For its coating and anodising plants (Fig. 10), TALEX ordered CIE Srl a fully automated chemical-physical waste water treatment system. It will be implemented in three phases up to achieving the zero-liquid discharge goal (Fig. 11). The high-precision manufacturing unit integrates crimping, precision machining with 4 and 5 axis high speed CNCs, cleaning, deburring and custom-length cutting processes. The mechanical properties of the crimped profiles are tested in compliance with the BS EN 14024 and the international standards. Finally, TALEX has created a fully automated logistics and handling unit to ensure fast, flexible and responsive packaging and dispatch.

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The high-precision manufacturing unit

A horizontal coating plant for greater flexibility

“When signing our contract, TALEX asked us to design a very innovative coating plant, especially in terms of automation, in order to reduce the number of operators on the line and achieve maximum flexibility,” says Franco Gioia, the Area Manager of Trasmetal. “The choice fell on a horizontal painting line for two main reasons: the considerable weight of some profiles and the versatility required to coat profiles with different sizes and shapes, and above all intended for very different applications, which translates into equally differently paints and thicknesses to be applied. Moreover, the plant was designed and equipped with all the devices needed to dedicate the right time to each process stage, with the aim of obtaining high-quality finishes. Vertical lines ensure high quality and high productivity, but they do not allow for the integration of any touch-up stations. However, these are crucial for a firm that mainly manufactures profiles for industrial use like TALEX, since the homogeneity of thicknesses and the variability of shapes call for greater application accuracy also in the most difficult to reach areas. “An important feature of this plant is Futura Convogliatori Aerei’s power & free conveyor. With a net load capacity of 500 kg (1,000 kg, including the weight of bars), it is impressive for an aluminium profile coating line (Fig. 12). It is characterised by several storage buffers along the path of the jigs, ensuring a flexible process flow with no bottlenecks nor productivity losses (Fig. 13). For the loading and unloading stations, we were asked to keep the general layout of the factory in consideration, in order to allocate as much space as possible for these two stages and, at the same time, integrate some downstream



Figure 7: From left to right, Trasmetal Area Manager Franco Gioia, TALEX Operation Manager Sajid Hussein, TALEX Surface Treatment Manager György Hegedüs, and CIE Srl Technical Manager Rosario Patricelli.



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Figure 8: A side view of the coating system.

operations such as packaging. Since the jig management structure is located at the second level, the loading station has two precise drop sections from which the jigs descend to enable the profiles to be hung (Fig. 14) and through which they return to be automatically transferred to the robots of the immersion pre-treatment line (Fig. 15). The robots have a lifting capacity of about 2,000 kg because they handle 3 bars at a time. The immersion pre-treatment line is also ready for the possible integration of an alkaline degreasing process and its related rinsing stages with countercurrent fresh water, which are not included at the moment.

“As for the powder application phase, TALEX required two high productivity booths with a quick colour change system. We opted for Gema’s Magic Cylinder booths (Fig. 16) featuring a conventional powder feeding system with Venturi injectors (Fig. 17).

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Figure 9: The “short” anodising line.

The peculiarity of this solution is that the two booths can also work simultaneously, if there is the need to reduce the line speed due to the geometrical complexity of the profiles, without this resulting in any loss of production. However, in the case of a standard production, one of the two booths is devoted to light colours, the other to the dark ones (Fig. 18). Again with the aim of maximum flexibility, they both feature downstream and upstream automatic buffers to ensure a fluid and adaptable process flow.

Trasmetal collaborated with other suppliers of TALEX, such as the company that produced the in-line packaging machine, in order to integrate all the coating plant stations with the general layout. The profile unloading area (Fig. 19) has two workstations: one in line with the packaging machine and the other devoted to special profiles that cannot be packaged.”

“The high-water saving pre-treatment process starts with an acid degreasing stage in two tanks working in parallel,” states TALEX’ Surface Treatment Manager György Hegedüs. “This is followed by two rinses with countercurrent cascade fresh water and a rinse with demineralised water to safeguard the surface conversion phase. The conversion process uses a chrome-free, zirconium-titanium-based product. The last stage is another rinse with demineralised water. We chose to install two parallel drying ovens in order not to “stress” any process stage for time reasons and to be able to seamlessly tackle any increase in productivity in future. Currently, the plant handles 15 jigs/hour with a takt time of 4 minutes.”

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Figure 10: A bird's eye view of the building housing the surface treatment and automatic packaging department.

Figure 11: The chemical-physical treatment plant for the coating and anodising processes' waste water.

“The coating booths are air conditioned, pressurised and dust-free,” says György Hegedüs. “Once out of the drying ovens, the bars are diverted to one of the two application booths – all these transfer areas are closed to keep them separate from the working environment and they are equipped with an air recirculation and conditioning system that maintains the same temperature and humidity parameters in all seasons. Before entering the polymerisation oven, the profiles pass through an IR station with profile automatic recognition bars to adjust the distance of the jigs

from the IR panels (Fig. 20). Finally, the polymerisation time is adjusted according to the profile size, the paint thickness and the intended use of the product.”

“We chose Trasmetal as the supplier of our horizontal line based on its experience, technology, technical assistance and, last but not least, its ability to find the best solution to our needs. The most difficult request put to them was the design of a line that was perfect for different types of products, not just for architecture profiles,” states Sajid Hussein.

“Trasmetal manufactures only tailor-made lines: we do not have any standard product,” says Franco Gioia. “In time, we have built a few vertical lines for profiles up to 12 metres, but these are quite rare. Considering the requests of TALEX, we thought that a horizontal plant would have been more appropriate, especially because they produce items for both architecture and industry, including very heavy-weighted profiles. In the future, TALEX may well decide to add a vertical line devoted to architectural components only, if there will be an increase in the demand for this type of profiles.”



Figure 12: A bottom view of the power & free conveyor.

Figure 13: One of the storage buffers created along the conveyor to avoid any loss of productivity.

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Figure 14: The loading station. The two drop stations can be clearly seen.

Waste water treatment: a strategic element for competitiveness and sustainability

Sustainability is an important component of TALEX’ mission, especially considering that this aluminium extrusion giant is located in an area where water is scarce and where the government has imposed much more restrictive discharge limits than the European ones. “Waste water treatment is a critical stage: for us, it is vitally important to reuse process water and optimise its consumption,” says Sajid Hussein. “The

technology of CIE (Compagnia Italiana Ecologia) stands out amongst all the other in terms of efficiency and ease of management.”

“The waste water treatment and recovery system that we supplied to TALEX handles the whole amount of process water of the finishing department,” adds Rosario Patricelli, the Technical Sales Manager of CIE. “As we said, water is a major issue not only due to its cost and scarcity – TALEX currently receives water in tanks since the water connection is being completed – but also to the quality

standard imposed on discharges in terms of fixed residue (Total Dissolved Solids, TDS). That is why they asked us to implement a step-by-step project with the ultimate goal of creating a Zero Liquid Discharge plant, i.e. recovering at least 95% of process water. TALEX is now in Phase 1: we installed a chemical-physical treatment plant with the PURAL technology, which recovers all acidic waste water, i.e. the process water coming from the anodising and pre-treatment stages, and enables us to reuse it in alkaline rinses, thus achieving a 50%

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Figure 15:
The immersion pre-treatment line can handle 3 bars at a time to ensure the highest possible productivity.

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Figure 16:
For the powder application, TALEX chose two Magic Cylinder booths with a quick colour change system, supplied by Gema Europe.

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reduction in the water required by the finishing lines. The alkaline attack baths of the anodising process are currently stored and disposed of by a specialised firm, since treating them in this Phase would not enable us to respect the conductivity limit imposed on waste water, equal to 2,500 $\mu\text{S}/\text{cm}$. “During Phase 2, the recovery of the process water used on the finishing lines will increase to 75% thanks to the installation of special membrane recovery systems, i.e. ultrafiltration and reverse osmosis. Also the concentrates from the alkaline attack baths of the anodic oxidation process will be treated on the existing plants and will be not disposed of anymore. The last stage of the project, Phase 3,

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will involve the installation of energy-recovery evaporators (vacuum multi-effect devices) to treat the liquid coming from the osmosis systems. This will create a closed loop system for the recovery of waste water, with an efficiency of no less than 95%.” “By applying our proven PURAL system, we provided a very special water treatment process that enables TALEX to purify its acidic waste water by recirculating it in its alkaline baths, thus cutting consumption by 50% and meeting all the local regulations,” says Patricelli. “We have considered the different streams of water separately since the beginning. The waste

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ROTO PLUS 100 - 202 - 400 Atex II2G
 fino a 115 l/h - up to 115l/h



HR 600 - 1200 Atex II2G
 fino a 400 l/h - up to 400 l/h



Figure 17: The booths have 16 guns each and use the conventional Venturi powder feeding technology.



Figure 18: The inside of the booth applying dark colours.

water is conveyed into a transfer pit area where it is selected depending on its quality. Then, it reaches a large storage area ensuring a flexible production and avoiding any “stresses” even in the water treatment stage, because the quality of water is closely related to the quality of production (Fig. 21). From the buffer area, the waste water is sent to the treatment system: the chemical-physical process (Fig. 22) is already sufficient to significantly reduce the content of sulphates, aluminium, and organic residues and reach the quality level needed to feed the alkaline baths. In future, the alkaline stages’ water will be treated by removing any kind of contamination, especially

aluminium and COD. The discharged water meets the limits imposed by the local authorities. All machine operations are automatic (Fig. 23): the plant features all the BAT for SCADA systems, electronic devices and controls in order to minimise the maintenance times and facilitate the work for operators. It is ready for the implementation of Phases 2 and 3.” “Waste water does not make any profit,” states Rosario Patricelli. “Therefore, our goal is to design plants that require a minimum staff and the minimum possible time for every operation. CIE also supplies the closed-loop production plant of demineralised water used for the anodising and coating lines, while for the sludge treatment we have installed fully automatic filter presses without any operator supervision.”

TALEX: an industry 4.0 company

Similarly to all other production machines, both the coating and the water treatment systems have their own software package and an

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Figure 19: The profile unloading station is in line with the packaging machine.

TALEX equipment in numbers

Extrusion

- Direct presses 25MN & 35MN
- Automated log storage
- Gas and induction heated saw cut to length billets
- Water and air quenching
- Double bench double puller with controlled cooling, 64m length
- Up to 14.2 m final cutting saw
- Fully automated stacking and aging processes
- Bottom loaded single and double chamber aging ovens ± 1.5 °C accuracy
- Scroll down

Short anodizing

- Based on QUALANOD requirements and DIN17611
- Fully automated line with 6 cranes
- Maximum profile length: 7,200 mm
- Layer thickness: 5-25 microns
- Hot water sealing

Long anodizing

- Based on QUALANOD requirements and DIN17611
- Fully automated line with 3 cranes
- Maximum profile length: 14,200 mm
- Layer thickness: 5-25 microns

Powder coating

- According to QUALICOAT requirements
- Maximum profile length: 8,200mm
- Fully automated line
- Chrome-free conversion technology
- Gema Magic Cylinder booth

Alodine2040 Passivation

- Chrome-free passivation
- Coating weight: 2-10mg/m²
- Low surface resistance, after long storage
- Guarantee of weldability
- Guarantee of long-term bonding

Fabrication

- State-of-the-art fabrication unit providing services for crimping, precision CNC machining and customized cut-to-length profiles
- Mechanical properties of crimped profiles are tested as per BS EN 14024 and comply with international standards
- 5 & 3 – axis CNC machines
- Double & single head cutting saws
- Stretch bending machines
- Precision machining

Automated handling

- Fully automated die storage and die handling system with storing capacity of 7,000 pieces
- Fully automated finished goods storage with capacity of 4,000 crates
- Fully automated extruded profiles management and handling by three overhead cranes
- Fully automated profiles management before and after aging process with bottom loaded aging furnaces

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Figure 20: The IR station is used to gel the applied powders and avoid any possible contamination among different shades inside the oven.



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Figure 21: The quality of water is strongly linked to the quality of production.



Figure 22: Chemical-physical treatment tanks.

integrated PLC. However, they are also interconnected with the main management software used by the company to fully track each profile. These “dynamic brains” interact

with all production machines, taking and supplying useful data at the same time. “TALEX has fully applied the Industry 4.0 concept,” says Sajid Hussein. “The system

creates all processing reports, from liquid metal to packaged products. We can track the whole production process of every single profile, up to the molten metal used.”

TALEX is an advanced company operating in the United Arab Emirates, a booming market that is also totally open to the outside world to grasp opportunities of innovation wherever they occur.

“The production capacity of our coating plant is 7.5 t per hour, far greater than that of an average vertical system. There are not many horizontal plants in the world with such capacity; indeed, their productivity is normally six times less than ours is. TALEX’ ultimate goal is to take full advantage of the opportunities offered by the huge investment made and become a strategic player for the global industry.”

“ Similarly to all other production machines, both the coating and the water treatment systems have their own software package and an integrated PLC. However, they are also interconnected with the main management software used by the company to fully track each profile. These “dynamic brains” interact with all production machines, taking and supplying useful data at the same time.”



Figure 23: The touch-screen control of the waste water treatment system.