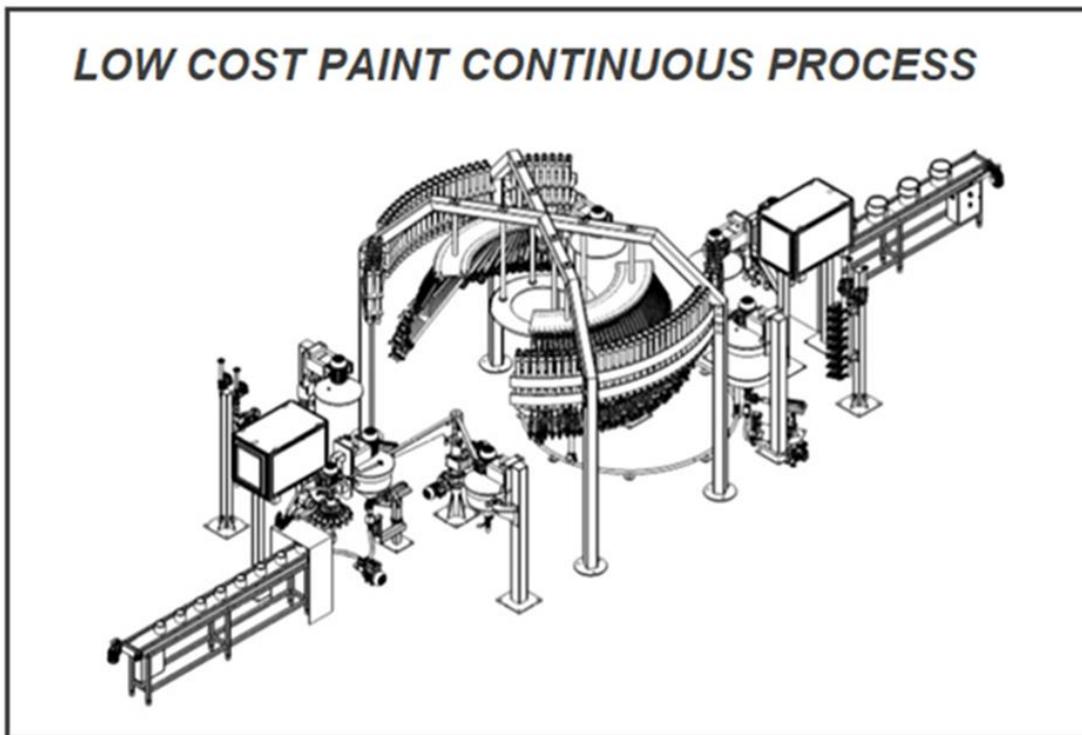




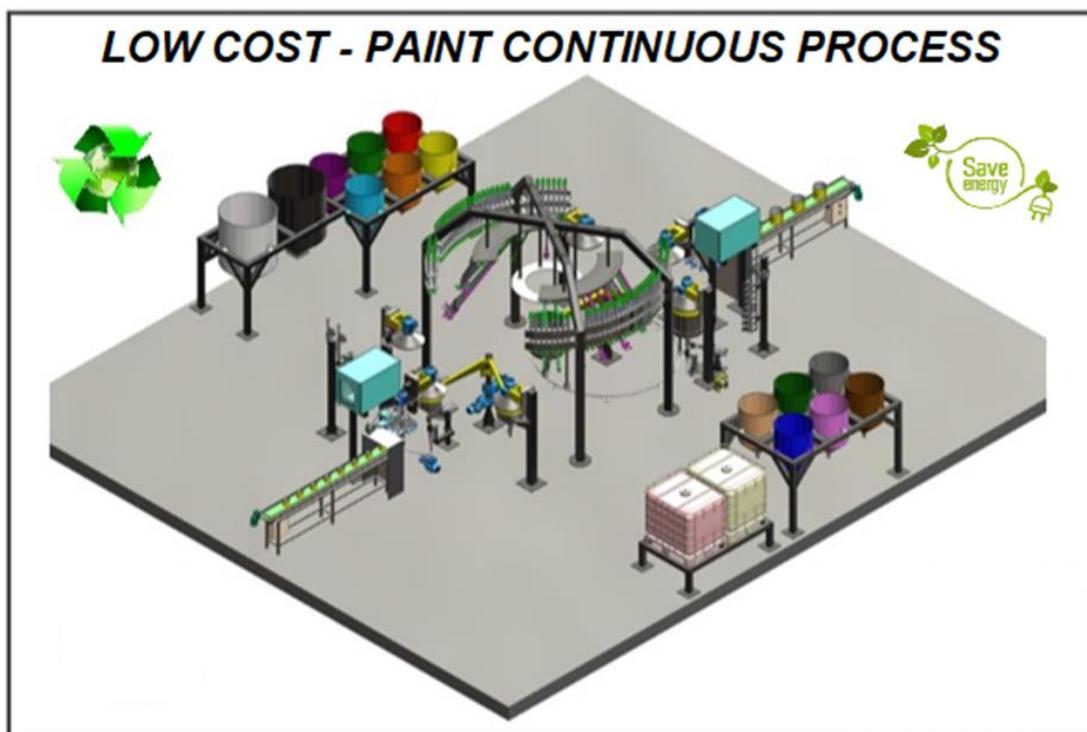
LOW COST PAINT CONTINUOUS PROCESS – The reality of Industry 4.0 has arrived in the world of paints. Fasten your seat belt and let's go to the future ...



The **RMA TECH**, through its founder, with decades of experience and patents in paint manufacturing processes, aware of the challenges facing the paint segment, decided to explore new paradigms for this sector, through the creation of cutting edge technology that enable evolutionary leaps in this sector, following the other industrial segments that are in more advanced stages, such as the oil, petrochemical, paper and cellulose, pharmaceutical, automobile sectors, among others, where Industry 4.0 already has the necessary bases for establish yourself.

On the other hand, the Paint Industry, both nationally and internationally, in practically all its manufacturing processes, has demonstrated a large technological gap.

Commonly "automatization", which translate into isolated mechanizations of industrial processes, are carried out in one or another unitary operation,



basically motivated by a better balance of the production line.

These evolutionary mechanizations, commonly called "automatization", however, bring little in terms of effective gains to the business, since they do not alter the production dynamics in terms of their flow, integrating the

various stages of the processes, until we reach a final product with low lead time, minimum variability and minimum cost, which, for example, the automotive industry has been practicing for decades.

It is easy to observe large stocks both in terms of raw materials and finished products in paint factories, which corroborates the thesis of the low manufacturing productivity of this segment.

Over the decades we have listened to several theses and explanations regarding this, however the real explanation is that the paint manufacturing processes, in the vast majority, are not capable, which implies that a “stock based strategy” is the safeguard adequate to manage the lack of capacity, accuracy, stability and productivity of the processes.

Large stocks, in the final analysis, demonstrate only the fragility and low capacity of the manufacturing processes, in the face of market demand, a paradigm already surpassed by several industrial segments, through highly robust, flexible and lean processes, where the stock is treated as heresy.

In these segments, "industrial automation", which is the result of the sum of "automation" plus "integration" and "intelligence", made possible real leaps in competitiveness through advanced strategies to control their processes, 100% integrated.

“Intelligent” processes, integrated and capable, lead to optimal solutions where the business gain is then maximized.

The time has come when the paint industries, driven by strong competition, low profit margins, high production costs, high inventories, resulting from low productivity and etc., change the manufacturing paradigm, using cutting-edge technological resources and technologies disruptive, to gain productivity and competitiveness on the international stage.

In this sense, RMA, focused all its expertise seeking to make the “intelligent automation” of the paint industries viable, where then, based on its previous patent of the 90's (**PCT / BR98 / 00099**), but with a more flexible and economical approach as for implementation, it created the new process concept called **LOW COST PAINT CONTINUOUS PROCESS RMA**,

having its international patent filed under the code **(PCT / BR2020 / 050084)**.

SUMMARY OF THE INNOVATIONS OF THIS NEW CONCEPT:

- Continuous production, with high performance, without downtime, maximizing productivity, with total online quality control and without human interference;
- Automatic production system with auto adjustment (control) of properties, such as COLOR, VISCOSITY, DENSITY, PH, CONDUCTIVITY, among others;
- ENVIRONMENTALLY CORRECT. It consumes about 50% less energy to produce the same amount of product, drastically reduces the emission of solvents to the atmosphere due to the closed system, low consumption of solvent for decontamination (color change), etc .;
- 100% aligned with the concept of 4.0 INDUSTRY;
- Greater accuracy and less manufacturing variability when compared to conventional technology, guaranteeing quality at the source for products manufactured from this technology;
- PRODUCTION UNDER DEMAND (make to order) concept, reducing inventories of finished products to minimum levels;
- Total elimination of “material / stock in process”;
- It does not require the use of materials with narrow quality bands (dyes, resins, bases, clears, etc.), because due to online measurement and control, it adjusts properties in real time;
- Factory Disponibility (Up-Time) over 95%;
- Algorithm of “Artificial Intelligence” (adaptive Machine Learning), which progressively incorporates the adjustments to the original formulas,

using this learning as pre-adjustments to the formulas, each time it is produced;

- Color measurement system in liquid base with line measurement cell (online), 100% automated, with self cleaning, self calibration, using DATACOLOR spectrophotometer and colorimetry software;
- Elimination of “human error”, considering that the process is 100% automated;
- Minimum 50% reduction in the operation team and great impact on the “CONTROL COST”;
- Uses about 25% of the area required for its installation, compared to conventional plants;
- Designed for installation / operation in Hazardous Areas in terms of explosiveness;
- Possibility of using existing fillers, after retrofitting, to be incorporated directly into the process;
- Full integration with corporate systems, ERP and databases, enabling the implementation of the Industry 4.0 concept;
- Remote support for maintenance, updates, improvements.

IDEA / CONCEPT PRESENTATION

The **LOW COST - PAINT CONTINUOUS PROCESS RMA**, is an autonomous industrial unit, designed for the manufacture of several families of products, processed from the mixture of several components, dosed from a Dispensing Machine Industrial, specially designed and with ability to dose more than 100 different components.

This unit operates continuously and with automatic adjustment of the main properties of the paints produced, such as COLOR, VISCOSITY, DENSITY, PH, etc.

This process, internationally patented under the code PCT / BR2020 / 050084, is based on a specially designed SMART DISPENSING MACHINE VOLUMETRIC, to which two SEMI CONTINUOUS PROCESSING UNITS have been added, with in-line technology for the analysis and correction of paint properties.

This new technology is derived from a process designed in the 1980s and patented by us in the 1990s **PCT/BR98/00099**, with units that have been operating for around 30 years around the world, mainly in units of AXALTA, previously DuPont Performance Coating.

The main difference between the two technologies is the fact that the previous technology had a 100% continuous concept and, thus, greatly limited its use due to the high cost of its implementation.

This meant that the previous technology ended up being segregated to very specific processes, oriented to high capacity plants and where the number of paint composition components to be produced was relatively reduced (between 15 and 25), in view of the high cost of implantation.

The advent of this new patent, radically changes this scenario because it incorporates the concept of using an industrial **RMA SMART DISPENSING MACHINE** for the pre-assembly of the paint, associated with continuous technology only for the continuous adjustment step.

This new concept ends up producing a brutal reduction in the cost of implementation, making it possible to use dozens of different components for the composition of several product lines in a single process.

In this way, the paints end up being produced in series as an assembly line for several different products and the most diverse colors possible.

Through Continuous In-Line Mixers, line analyzers and a computer system integrated with the Smart Dispensing Machine, this industrial unit allows the self-adjustment of the characteristics and properties of the processed products, without the need for rigorous previous adjustments of the characteristics of the formulation components that feed (pigment pastes, vehicles, bases, additives, etc.).

Due to these characteristics, this revolutionary process is capable of automatically producing, quickly and effectively, lots of paint within the specification ranges, especially the characteristics such as color, viscosity, density, etc., thus eliminating several steps conventional manufacturing processes, greatly boosting the volume of daily production, further reducing or eliminating the costs involved in the various stages of production suppressed, being 100% aligned with the concepts of INDUSTRIA 4.0.

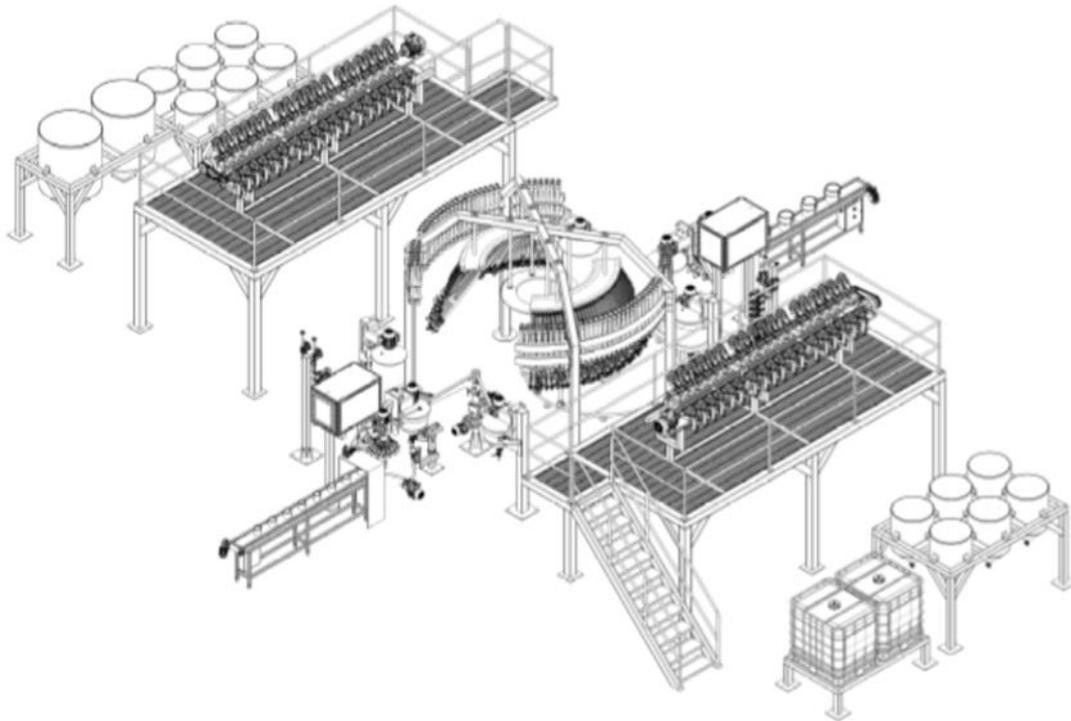
The “continuous processing units”, incorporated into the Industrial Dispensing Machine, operate through continuous line mixers (In Line Mixers), which, due to the small “dead volume” of their mixing chambers, compared to their flow capacity, make so that the “response time”, of changes that occur through continuous dosing of the adjustment components, are extremely low (in the order of 3 to 6 seconds).

This high speed of product renewal, both in the mixer chamber as well as in the cells of the line analyzers, are fundamental so that the computer system, through special algorithms, can act in the process, making extremely fast corrections in the product through continuous additions of adjustment components, seeking to reach product specifications in a short time and still maintaining product specifications, throughout the production cycle.

During the properties adjustment phase, while the specifications of the product in process have not yet been reached, the material that passes through the continuous processor (In Line Mixer) and that receives the “adjustment charge”, is recirculated to the process tank (Binary Tank), remaining in this mode (from 1 to 3 minutes), until the specifications are reached.

As soon as the product emerging from the “line mixer” reaches the specifications, the product flow at the outlet of this equipment is automatically diverted to the filling equipment, thus maintaining itself until the total consumption of the process tank contents. (binary tank) and without generating any material out of specification.

It is also worth mentioning that during the processing of the entire contents of the process tank, the control systems and analyzers remain.



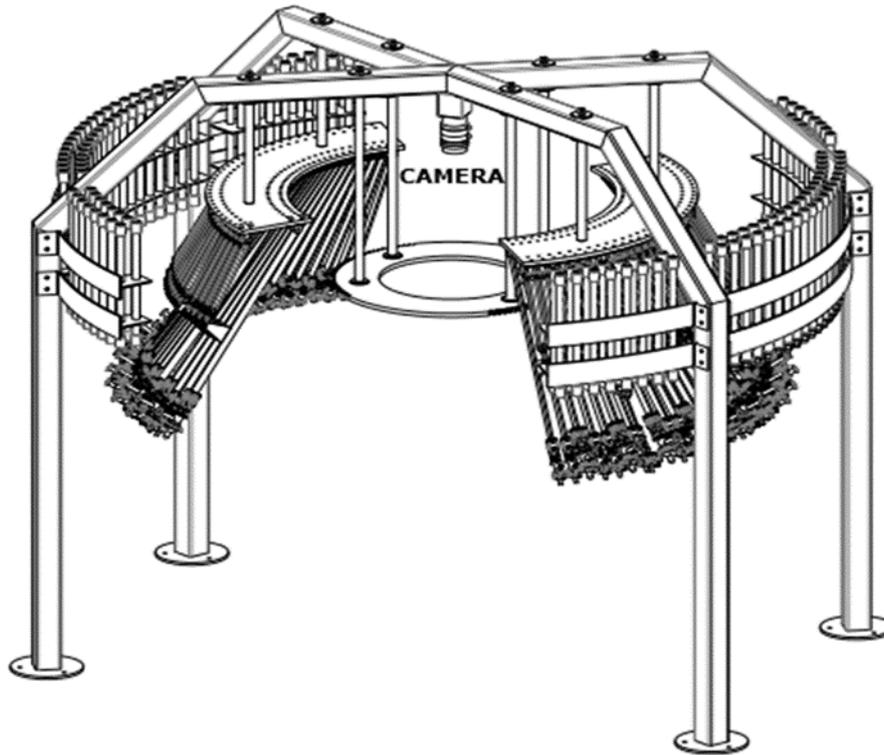
COMPONENTS OF LOW COST PAINT CONTINUOUS PROCESS:

a) One SMART DISPENSING MACHINE VOLUMETRIC with automatic and individual dosing system for each component (bases, pigment pastes, additives, etc.). This equipment has individual metering valves for each component, specially designed to provide fast and accurate volumetric dosages.

Said valves also provide the product recirculation through its internal cavity, avoiding sedimentation and consequent concentration of certain components due to eventual flow stoppage.

Due to the volumetric philosophy used, all component dosages occur simultaneously, drastically reducing the dosage lead time.

More details can be seen under the title [SMART DISPENSING MACHINE RMA - Accelerating manufacturing with intelligence and dosing precision. Towards "Industry 4.0" in the paint world].



- b)** Two Intelligent Dosing Platforms (Low Cost), composed of a set of dosing pumps driven each by a “shared central axis”.

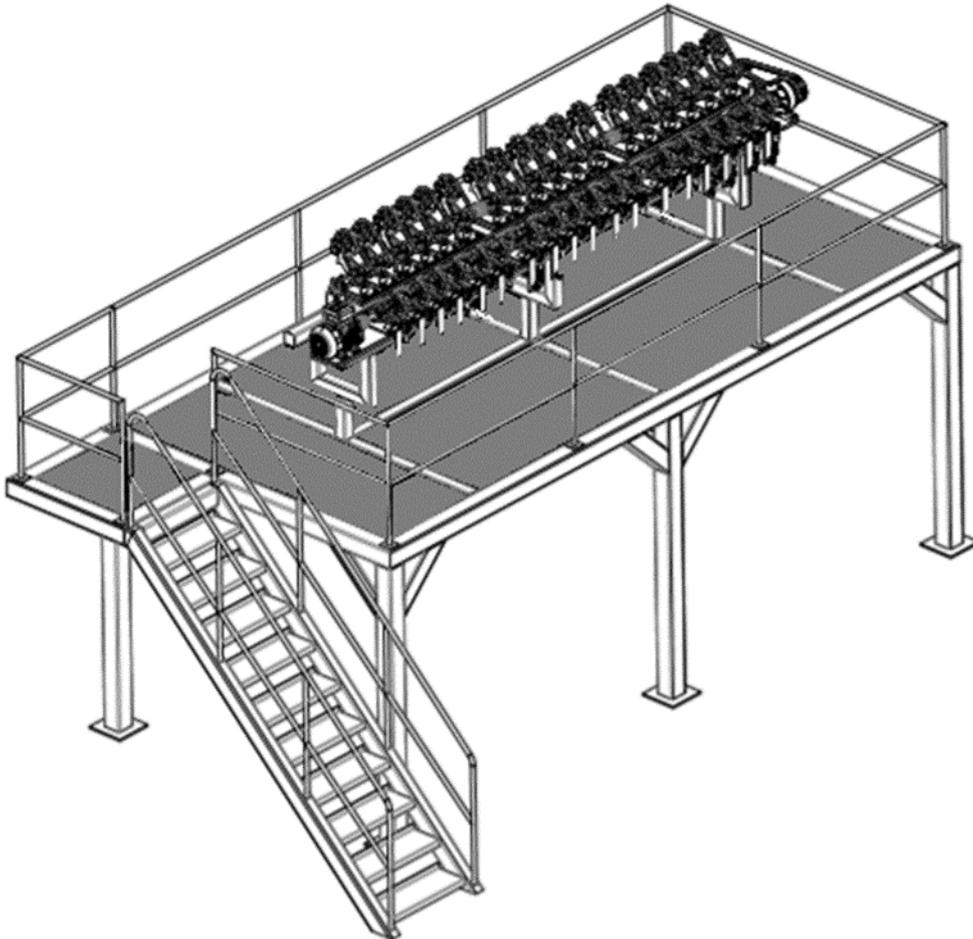
These platforms are arranged on the sides of the Dispensing Machine and are connected to the dispensing arms of the Dispensing Machine through rigid and flexible pipes.

The metering pumps used on these platforms are of the internal gear type (type VIKING), having an individual gearing device to the “shared central axis”.

Downstream of each metering pump, the individual volumetric calibrators (In-line Prover) are installed, responsible for the measurement and calibration of each metering pump. Pressure, temperature sensors and automatic directional valves are also installed

on these platforms to monitor the process conditions of each component to be dosed.

DOSING PUMP PLATAFORM



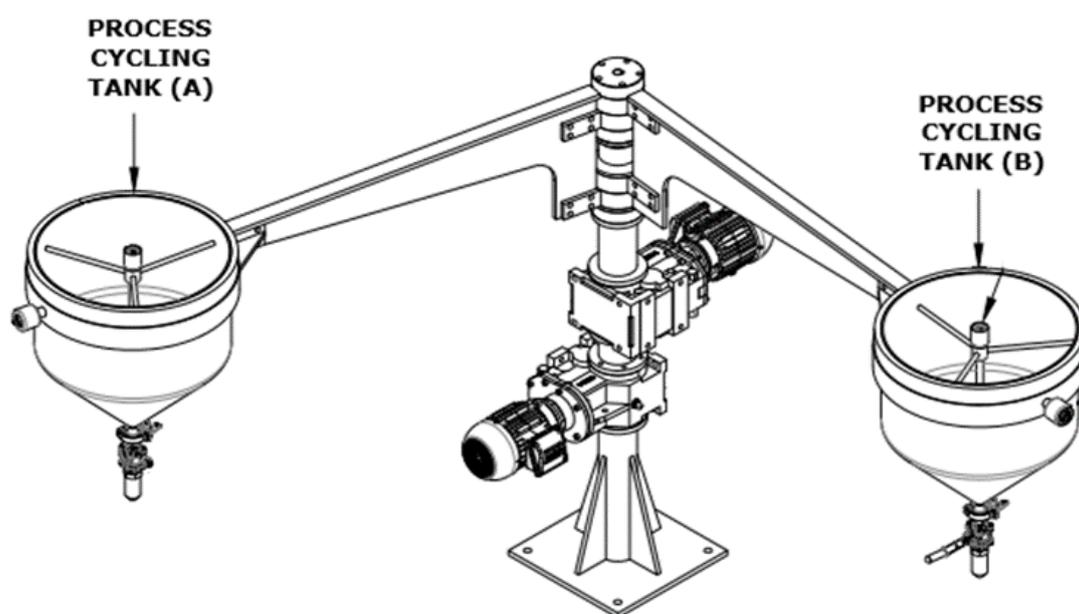
- c)** Two Units of Rotating Process Tanks (Binary Tanks), each unit consisting of a “central pivot” with two reducing motorcycles used to drive and move the process tanks circularly.

Said tanks have pre-defined stopping stations, as previously presented, and perform an anti-clockwise rotation, interleaving the process phases so that both the Dispensing Machine and the Filling Equipment have an occupancy greater than 95% of the useful time .

The tanks also incorporate an individual stirring system and automatic bottom valves for connections with process stations.

The volumes of each set of binary tanks can be different, further increasing the manufacturing flexibility, allowing the batches to be produced in different volumes.

ROTATING PROCESS TANKS

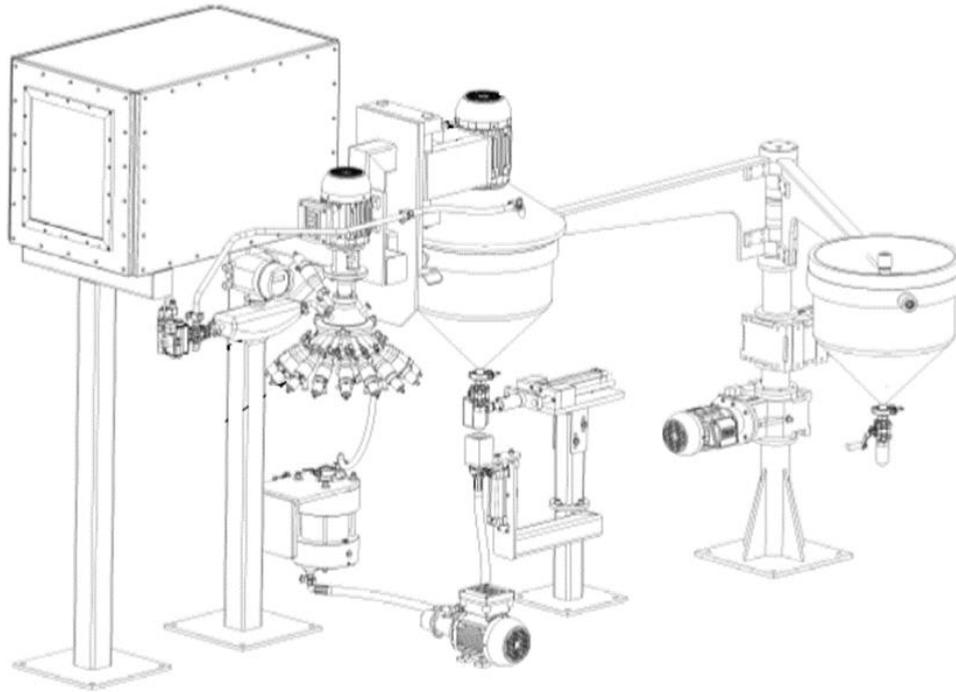


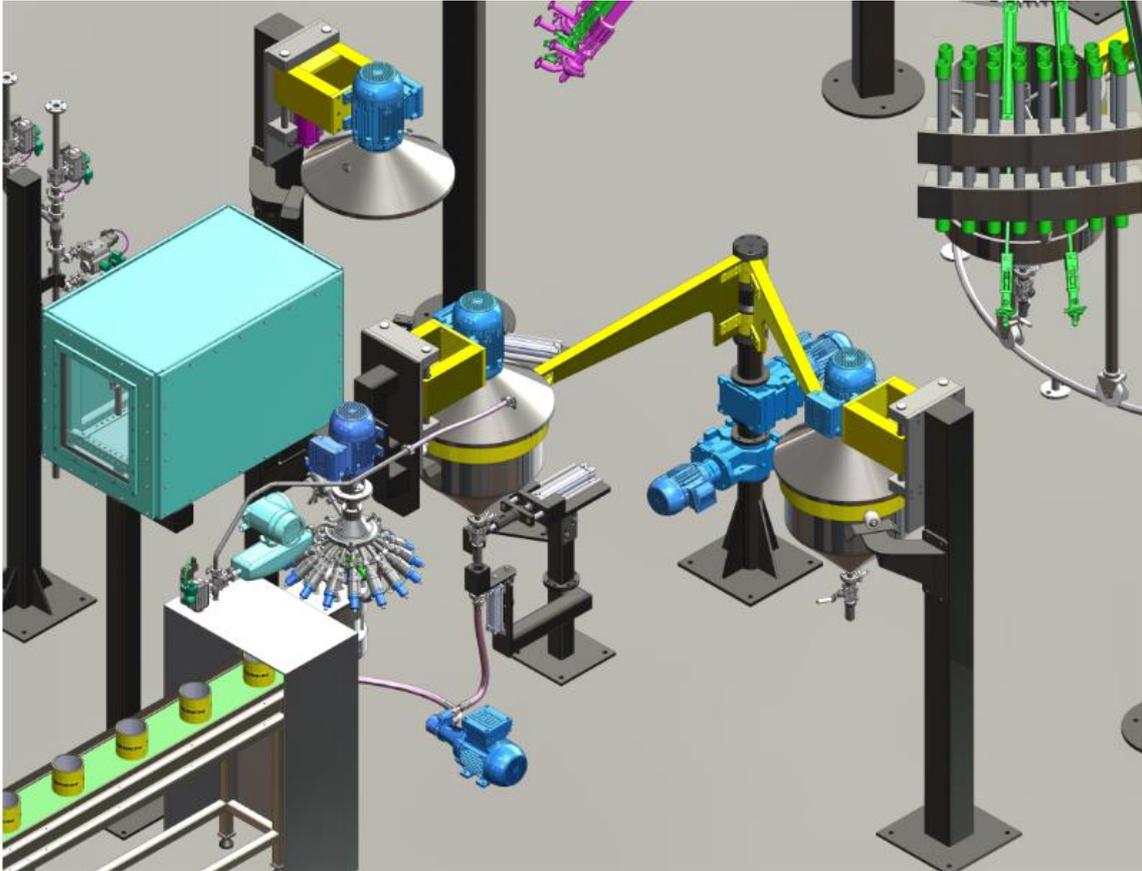
- d)** Two Continuous Processing Units with automatic adjustment of paint properties (color / viscosity / density, etc.), with online measurement, analysis and correction.

Each unit has a low dead volume In Line Mixer, specially designed to receive the “adjustment charge” continuously through dosing pumps and direct injection valves in the mixer chamber, providing “times response” of the order of seconds.

The Continuous Processing Unit also has line analyzers specially designed for continuous measurement of the COR variable on a “wet basis” and also viscosity and density, through a mass meter by Coriolis effect, and can also receive other types of analyzers (PH, Conductivity, etc.) according to need;

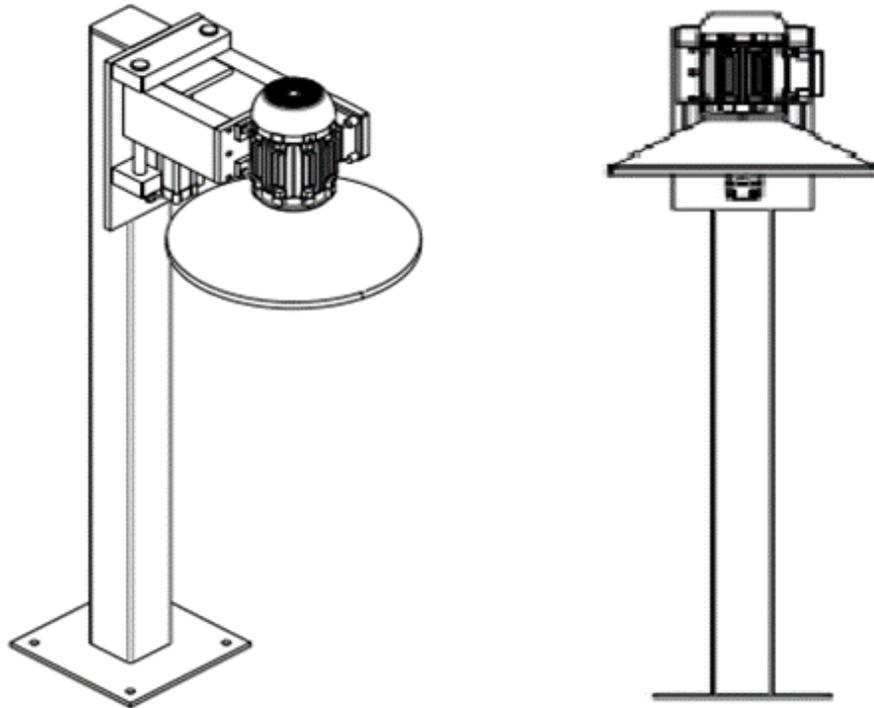
CONTINUOUS ADJUSTMENT STATION





- e) Two Pre-Mixing Stations where the contents of the process tanks are homogenized before starting the adjustment process in the Continuous Processing Units; These stations are installed before the Continuous Processing Units, having a movable cap that automatically attaches to the binary tank, providing a perfect seal and preventing splashes or material leakage during the pre-homogenization stage.

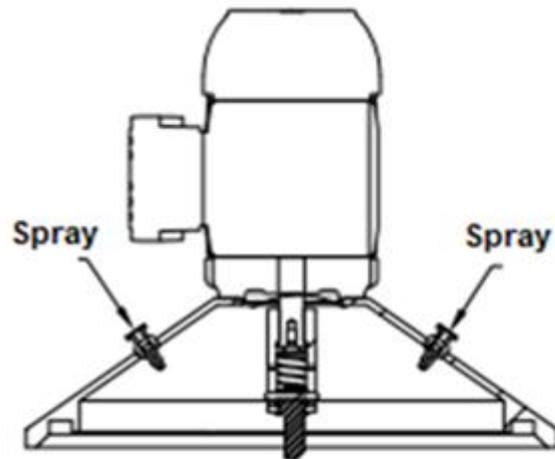
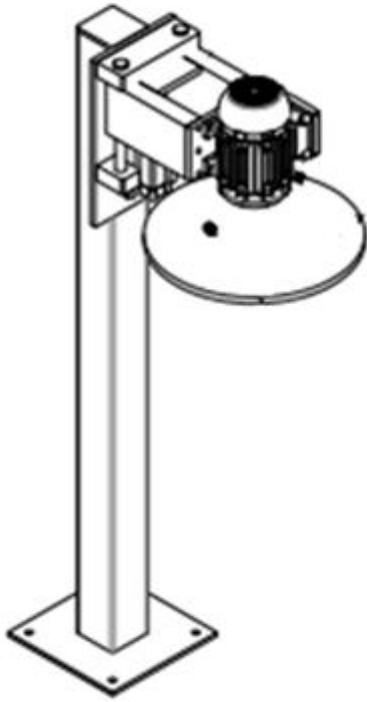
MIXING STATION



- f)** Cleaning Stations where the process tanks are automatically cleaned by spraying solvents to remove residues from the walls of the tanks.

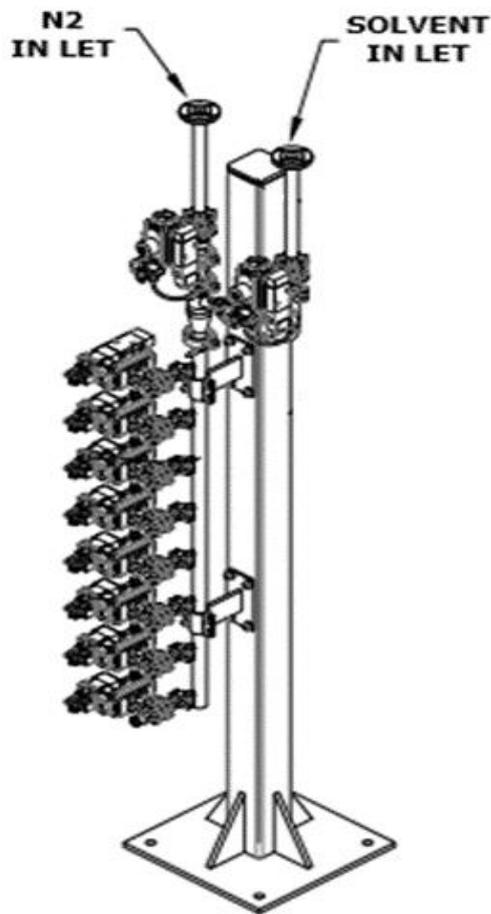
These stations are installed later on to the Continuous Processing Units, having a mobile hub that automatically attaches to the binary tank, providing a perfect seal and avoiding splashes or leakage of cleaning material during this stage of the process.

CLEANING STATION



- g)** Two solvent mist generators with nitrogen, specially designed to decontaminate the different parts of the process throughout the production cycle;

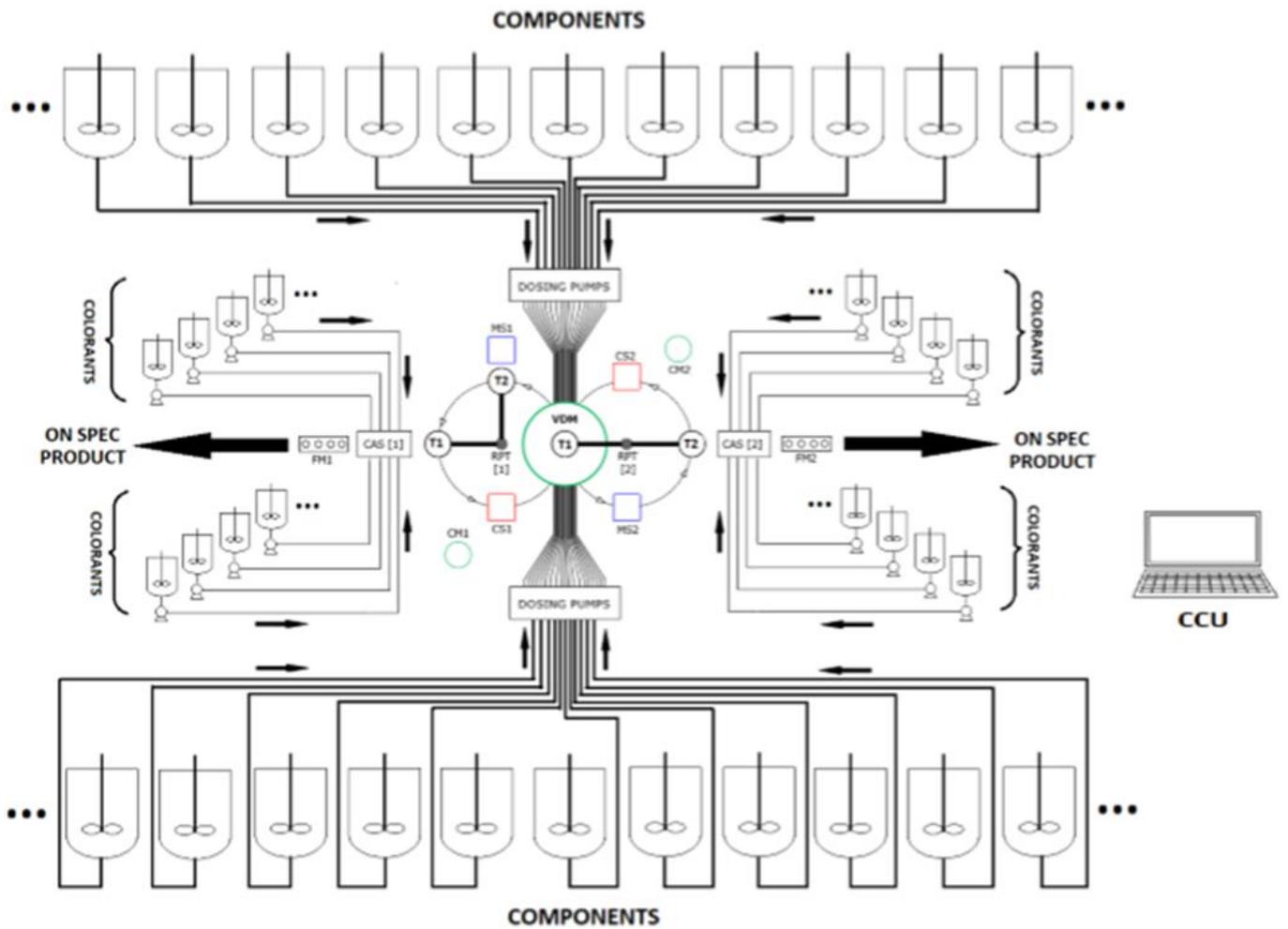
CLEANING MANIFOLD



- h)** A Computational Processing Units composed of PLCs (programmable logic controllers), computers, process supervision systems and man-machine interfaces, responsible for all process sequencing, analysis and computational processing for adjusting paint properties in continuous regime and gateways communication with databases, corporate systems, ERP, etc.

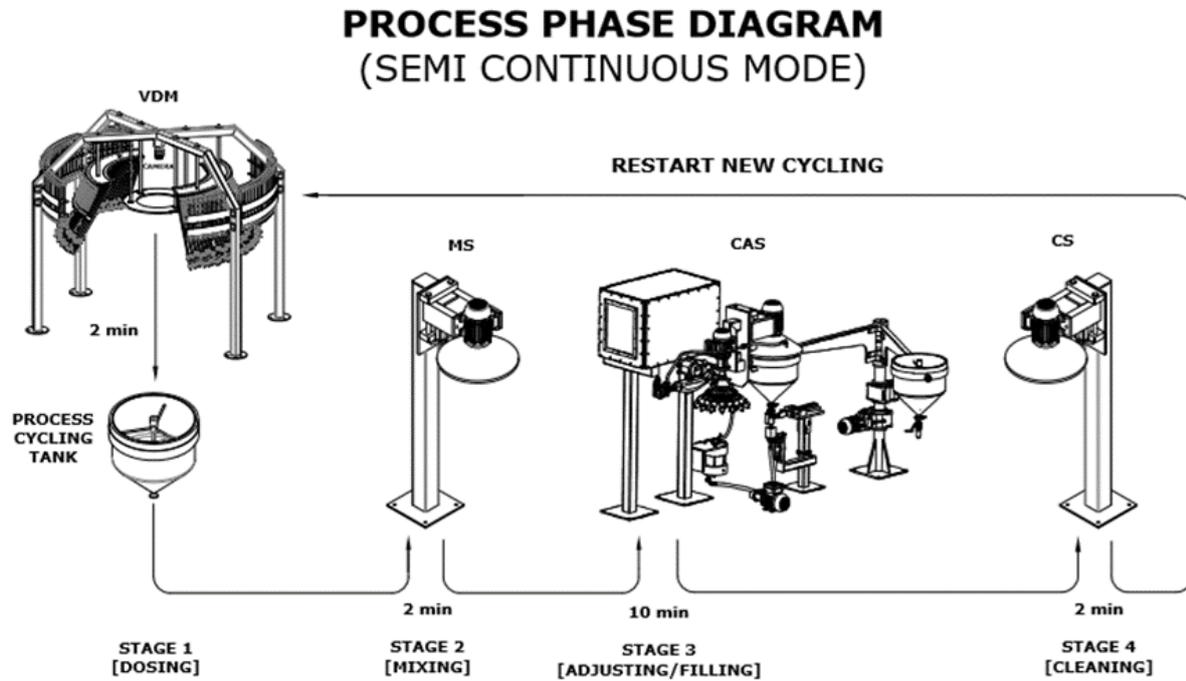
QUICK DESCRIPTION OF SYSTEM OPERATION

The picture below shows a schematic representation of the topology of the **LOW COST PAINT CONTINUOUS PROCESS**.



The next picture shows the representation of the **PHASE DIAGRAM** of one of the “binary tanks” performing the various functions that it performs throughout its trajectory in its production cycle.

It is important to note that the **LOW COST PAINT CONTINUOUS PROCESS**, has 4 tanks (two sets of binary tanks) that perform these steps in a fully automated and synchronized way.



In a simplified way, according to the figure above, briefly, we can identify 4 distinct phases, to which each of the four cycling tanks (binary tanks) performs the production cycle, namely:

PHASE 1 (Dosing): In this station, all the components of the formulation are dosed, through SMART DISPENSING MACHINE, simultaneously into the cycling tank (binary tank);

PHASE 2 (Pre-Mixing): After dosing the components in the Dispensing Machine, the tank automatically moves to the Pre-Mixing station where the sealing cap automatically engages the tank, simultaneously engaging the homogenization system, when the mixing process starts for a period of about 2 minutes;

PHASE 3 (Adjustment and Filling): After completing the Pre-Mixing step, the tank automatically moves to the Adjustment and Filling Station, with its bottom valve automatically coupled to a circulation pump.

In this station, the central element is an In-Line Mixer, which receives every load of material in adjustment.

In-Line Mixers, in addition to the input of the material to be processed, have several additional inputs, for COLOR adjustment dyes, VISCOSITY adjustment solvents and still other materials intended to adjust other properties (PH, Conductivity, Coverage, etc.).

The circulation pump of this station, when starting the adjustment process, conducts the material through the In-Line Mixer and when it is expelled in its discharge, it is directed to the analyzer system, circulating through these and finally conducted to a posterior directional valve , the cycling tank (binary tank) positioned for material recirculation.

With the In-Line Mixers having an extremely low dead volume, their residence time is in the order of 6 to 10 seconds, which makes the control action of the analyzers extremely fast.

Thus, the adjustment process, for complex variables such as COLOR, VISCOSITY, DENSITY, among others, ends up being very fast, occurring simultaneously in a period of 1 to 3 minutes.

As soon as the information from the analyzers begins to reach the PLC (Process Controller), these are processed and translated into flow rates of the adjustment material pumps, continuously changing the relationship between the flow of material in process and the flow rates of the components of adjustment, in order to achieve the specifications of the material in process.

During the stage when the computer system has not yet reached the specifications of the material in process, the flow of this material is continuously recirculated to the process tank that is under permanent agitation.

At the exact moment when the system reaches the product approval ranges, the directional valve posterior to the analyzers is then aligned to the

filling machine, remaining in this stage until the cycling tank (binary tank) is completely emptied.

It is worth mentioning that this cycle of measurement and adjustment of properties occurs continuously, during the processing of the entire batch in production, with all these measurements and adjustments being recorded in a specific database, providing the history of the entire race and with high sampling frequency.

PHASE 4 (Binary Tank Cleaning): After the cycling tank (binary tank) has been processed at the setting of properties and filling station, the tank moves to the Cleaning station where a sealing cap automatically engages on top of the tank, simultaneously engaged the tank agitation system, and a discharge connector at the bottom of the tank.

The upper cap has Spray nozzles that nebulize a mist of solvent and Nitrogen at high speed, removing all dirt from the agitator walls and blades, while a discharge pump connected to the bottom of the tank depletes the dirty solvent in this operation.

As every production cycle is very fast, about a few minutes, the paint adhered to the walls of the tank is not yet dry, making cleaning extremely easy.

At the end of this cycle, the tank is able to receive a new material load, automatically moving to the **PHASE 1** station, once the Dispensing Machine is released for a new dosage.

Note: We suggest viewing the movie about this process that shows this sequence and simultaneously with the four binary tanks.

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