



*Municipal Solid
Waste....
A Worldwide
Dilemma*

One of the most pressing problems faced by societies all over the world is related to their ability, or inability, to properly handle all the waste they produce without causing irreparable damage to our common environment. World population growth further compounds this problem, due to the corresponding, ever growing volume of Municipal Solid Waste (MSW) generated by this growth.

Historically, all waste generated was indiscriminately disposed along riverbeds, dumped from barges or ships into the oceans, used as fill in swampy areas, or burnt in open piles. As societies evolved and became aware of the environmental damages caused by such disposal practices, the use of Controlled Landfills began, and soon thereafter, protective liner membranes were required by regulations on new landfill specifications.

The numerous negative environmental impacts of landfills, aggravated by limited regulatory guidance and oversight, has resulted in extreme difficulty in approving new landfills. Strong public opposition associated with the negative impacts of MSW landfill has resulted in legislation and policies aiming to reduce the volume of MSW disposal in landfills. These policies have led to the development of curbside recycling, drop-off centers and the emergence of single stream Material Recovery Facilities (MRFs), which process source separated recyclables, and mixed MSW Material Recovery Facilities which process raw mixed garbage, nicknamed “Dirty MRFs”. Material Recovery Facilities (MRFs) have proven costly to build and operate and are relatively ineffective in recovering recycled materials.

Since landfill liners were designed to protect against contamination of our precious drinking water aquifers, and liner companies typically only warrant their membranes for twenty years, it is obvious that these membranes will eventually leak. Thus, it is imperative to avoid allowing organic materials from reaching solid waste landfills.

Many developed nations have begun implementing strict regulations establishing “time and weight specific targets” to reduce landfill disposal of harmful organics and valuable recyclables contained in MSW, with the ultimate goal of reaching an 80 to 90% recovery (recycling) of all MSW generated, aiming to achieve a “0” Landfill Target. Several countries, such as those forming the United Kingdom and EU, have legislated financial incentives and penalties associated with each progressive MSW diversion goal.

As an answer to landfilling and dirty-recycling, various alternative technologies have been developed.

Thermal processes, such as incineration, gasification, pyrolysis, and plasma arc were developed to dispose of the MSW as generated, and some of these technologies were coupled with steam and/or electrical power generation facilities. As a result, the waste was diverted from the landfills and useful energy was generated for the municipalities that implemented them. Unfortunately, incineration and some of the emerging technologies still produced various gaseous emissions resulting from combustion or conversion of chlorinated plastics, and waste ash contained inorganic contaminants from the mixed, unsorted MSW. Such thermal processes cannot fully minimize carbon emissions and residual ash quantities and toxicity without separation of inorganics and plastics prior to processing.

Carbon emissions avoidance and maximum landfill diversion are critical requirements of many new Request for Proposals (RFPs) by public and private waste entities.

Following a different pathway, biochemical technologies have also emerged, such as Anaerobic Digestion and Hydrolysis. These technologies, although useful and effective, are limited to single waste streams, thus resulting in large quantities of residuals, containing a mix of inorganic and organic materials unsuitable for beneficial reuse.

Environmentally Safe Handling of MSW... A Global Requirement

The global awareness of the Negative Environmental Impact that traditional MSW disposal methods have created, has brought about the development of International Agreements regulating polluting practices, including the disposal of MSW.

Most Industrially Developed Nations have begun implementing strict regulations establishing “Time and Weight Specific Targets” to reduce the disposal of the generated MSW, with the goal of reaching an 80 to 90% recovery (recycling) of all MSW generated, aiming to achieve a “0” Landfill Target. Several countries, such as those in the United Kingdom and the EU, have legislated financial incentives and fines associated with each progressive MSW percentile reduction target, establishing specific dates triggering these financial incentives and fines.

Understanding the difficulties associated with MSW, ***Any MSW Handling and Material Recovery Method*** selected by a community must comply with the following requirements:

- Positive Environmental Impact
- Effectively reduce MSW “Weight Quantities” Below required Targets
- Allow the Mechanical Recovery of Useful and Marketable Materials in MSW
- Residual materials to be landfill must NOT be Toxic, Polluting or Hazardous
- Capable of Expanding Processing Capabilities as Population Grows
- Capable of operating in Privately or Publicly Owned Facilities
- Financially Viable NOT increasing Tax Liability

The T&B Fabrication Treatment of MSW... The Key for an Effective Material Recovery

The T&B Fabrication treatment of MSW is centered in the ***Rotoclave***[®] processor, which is a static steam autoclave pressure vessel fabricated with a patented unique internal rotating drum, fitted with angular surfaces designed to load, move/ agitate and discharge the totality of materials contained in the internal drum.

The ***Rotoclave***[®] processor is a batch operated system, with a loading, processing, and unloading batch time ranging from 60 to 120 minutes per processor. This processor is being widely used around the world, treating a wide variety of waste-streams. Currently there are more than seventy (70) ***Rotoclave***[®] installations worldwide, with more than one hundred (100) ***Rotoclave***[®] processors of various sizes operating.

The ***Rotoclave***[®] processor allows the treatment of ALL MSW without “Pre Separation”, thus making it possible to process the MSW as it is collected from every Residential, Commercial and Industrial neighborhood, including any “unpredictable” content variability in composition, mix, volume, density, and moisture.

Although the **Rotoclave**[®] does not require “pre-sorting” of the waste stream, most of the post **Rotoclave**[®] treatment separation equipment will have some problems handling “over size, bulky” materials such as refrigerators, dishwashers, furniture, and/or long fabrics such as carpet rolls or draperies. Therefore, most facilities remove these large items prior to feeding the “raw MSW” into the **Rotoclave**[®] processing vessel.

Additionally, depending on the facility post-treatment technologies selected to achieve the client’s financial goals, many materials that do not possess market value, but high energy value, would reduce their energy value while exposed to the operating parameters of the **Rotoclave**[®] treatment, therefore their pre-treatment separation is desirable as well as suggested.

The **Rotoclave**[®] technology of T&B Fabrication subjects the raw MSW to agitation, pressure, heat, and moisture from the injected Saturated Steam. This combination of pressure, high temperature and moisture, in conjunction with the unique method of agitation, ensures that the totality of the MSW materials being processed will be exposed to the sterilizing live steam.

The extreme processing conditions in the fully automated **Rotoclave**[®] processor, allows for applications across a wide variety of fields, such as for the treatment of Regulated Medical and Pathological Wastes (RMW), Port Wastes (airports and seaports), Laboratory and Veterinary Wastes, Abattoir Waste and Dry Digestion Processing, BSE Processing, Raw Pulp for Cardboard and Paper production, as well as Municipal Solid Wastes (MSW), for which it was originally designed.

The **Rotoclave**[®] process sterilizes all waste, thus eliminating any pathological condition that might be present in the MSW, whether due to organic putrefaction, discarded infectious waste in the MSW stream, or from other sources. This sterilizing capabilities not only provides a peace of mind to the operator, assuring its workers that they will not be exposed to health dangers, but also providing full compliance with strict regulatory precepts established by some countries to handle specific types of wastes, such as Abattoir waste, Animal Meat preparation and trimming plants, Restaurant and Supermarket waste, whether from residual food preparation or discarded outdated or putrefied food.

Additional to the sterilization benefit associated with the **Rotoclave**[®] processing, the mechanical agitation of the MSW created by the rotating internal drum generates a Significant Volume Reduction.

The resulting product of the **Rotoclave**[®] processing, is a Sterile and Volume Reduced Waste stream, which is the “Key” for an effective separation of Organic Fiber and Clean Recyclates by existing industry proven mechanical equipment. This effective mechanical separation of Recyclates in the **Rotoclave**[®] system, without the need of the costly and cumbersome curb recycling or dirty MRF programs, provides Clean and Inexpensive Organic Fiber, Metals and Plastics Recyclates easily sold in existing markets worldwide.

Recovery of the Organic Fiber from the MSW

The **Rotoclave**[®] effectively breaks down and pulps all biodegradable materials in the MSW stream, including cardboard, diapers, paper, and the like, and transforms all these biodegradables into a fibrous pulp. This fibrous pulp, or flock, is easily separated from the balance of the treated MSW materials, through the use of mechanical screens (trommels, vibratory, etc.) and proprietary density separation systems, thus allowing efficient separation, recovery and beneficial reuse of organic materials in the MSW.

The recovered/ recyclable fibrous pulp/ flock, largely cellulose and hemi-cellulose, can be directed to several emerging, environmentally friendly biomass “conversion technology” applications. Selection of conversion technology in turn drives application of specific biomass pre-treatment equipment, such as density separation, dewatering, size reduction, drying, and/or densification options.

Some of the multiple environmentally friendly markets for recovered biomass include:

- Acid, alkaline, or enzymatic hydrolysis for production of ethanol and/ or other specialty chemicals.
- Gasification with renewable energy production from produced synthetic gas via engine generator sets, highly efficient turbine systems or fuel cells, or conversion syngas to liquid biofuels such as butanol, ethanol, synthetic gasoline, or synthetic diesel.
- Pyrolysis with conversion of produced pyrolysis oil to renewable power or liquid biofuels.
- Anaerobic Digestion for renewable power generation.

T&B Fabrication recycling systems facilitate diversion of organic waste from landfill, thus eliminating creation of landfill methane. Fugitive emissions of methane are widely recognized as a major contributor to global warming, as methane gas is many times more harmful than carbon dioxide or carbon monoxide. T&B Fabrication systems facilitate recovery of virtually all recyclable metals, plastics, glass, and textiles for beneficial use. T&B Fabrication systems eliminate future creations of hazardous landfill leachate associated with landfill of organic waste. T&B Fabrication systems facilitate displacement of non-renewable forms of electricity and/or transportation fuels and reduce our Nations’ dependence on foreign crude oil.

T&B Fabrication recycling system implementation results in the diversion of Over 80% of MSW from landfill, while doubling recovery of recyclables over the average curbside collection program. Limited remaining landfill life is increased by as much as four to five times.

The *Rotoclave*[®] effective transformation of biodegradable materials into pulp (typically averaging 60% of the total MSW waste stream), allowing easily separation by standard mechanical separators, is the key factor allowing the high rate of recovery of recyclable materials with market value, using existing proven technologies.

Recovery of the Metals from the MSW

The *Rotoclave*[®] effectively processes Ferrous and Non-Ferrous Metals maintaining their structural integrity, and during the typical batch processing inks and paper labels are removed from the metal surfaces.

The Ferrous Metals are separated using well proven Magnetic Separators, and the Non-Ferrous Metals using proven Eddy-Current Separators. From the cages holding the recovered metals, these are baled using standard baling equipment. The baled Recyclates are transported to the recycling markets by standard commercial means.

There are metals in the MSW that are difficult to separate due to their manufactured nature, such as electrical wires and/or metal shelving covered or coated with plastic. Each facility would have to make its own determination on whether to provide additional laborious separation stations to recover these materials, or to just dispose of them into landfills including them in the discarded percentages of the total weight processed.

Recovery of the Plastics from the MSW

Plastics processed in the **Rotoclave**[®] system will alter their physical state to various degrees, depending on their chemical structure and density. The deformation temperature of the various plastics will have great bearing in the extent of its change/ modification during the processing in the **Rotoclave**[®] vessel.

PET or PETE materials such as in drinks/ liquids containing bottles, food containers, microwavable trays, and the like, will come slightly shrunk and/or flattened, but intact. These materials can be separated using conventional Optical Sorters and/or Other Plastic Recognition Technologies.

HDPE materials come in different shapes, thickness, and densities. The lighter HDPE materials as those used for retail/ grocery bags will deform and form little balls, resembling pebbles. They can be mostly separated from the organic fibrous stream, after the metal separation at the inorganic screens and separators. All other HDPE will be deformed to an extent depending on the thickness of its application. Milk, water, and juice bottles will flatten, shampoo, dish/ laundry detergent or household cleaner bottle/ containers, and shipping containers will mostly retain their shape and size. These materials can be separated using conventional Optical Sorters and/or Other Plastic Recognition Technologies.

PVC materials also come in different thicknesses which will be affected differently by the **Rotoclave**[®] processing. Most PVC packaging (bags for bedding, shrink wrap, deli and meat wrap, etc.) will shrink greatly, forming balls such as described under HDPE materials. They can be mostly separated from the organic fibrous stream, after the metal separation at the inorganic screens and separators. Other PVC applications such as liquid containing bags, tubing, wire, and cable insulation, is separated using conventional Optical Sorters and/or Other Plastic Recognition Technologies, alongside the rigid containers and floor tiles, etc.

LDPE materials also comes in different thicknesses which will be affected differently by the **Rotoclave**[®] processing. All packaging materials (such as laundry bags, garbage bags, frozen food or produce bags, etc.) will deform and their recovery mostly depends on their volume and commercial viability. They can be mostly separated from the organic fibrous stream, after the metal separation at the inorganic screens and separators. Other LDPE, such as the ones used in toys, container lids, squeezable bottles (honey, mustard, etc.), and beverage cups can be recovered using conventional Optical Sorters and/or other Plastic Recognition Technologies.

PP materials are slightly deformed by the process heat, and recovered at various streams, depending on the material sizes. Little bottle caps and closures can be mostly separated from the organic fibrous stream, after the metal separation at the inorganic screens and separators. Larger sizes such as yogurt, margarine containers, takeout food containers, medicine bottles, food bottles such as catsup or syrup, can be recovered using conventional Optical Sorters and/or other Plastic Recognition Technologies.

PS materials typically retain their shape and slightly deform depending on the size of the container, or whether it is fabricated with other materials such as rubber in High Impact Polystyrene (HIPS) applications. Typically, materials such as food service items (cups, plates, bowls, cutlery, hinge takeout containers, meat/ poultry trays, and rigid food containers for yogurt, etc.) are slightly deformed. Other applications such as used in the fabrication of toys, video cassettes, cloth hangers, electronic housings, cable or thread spools, compact disks cases and / or medicine bottles, will mostly retain their shape and size, and can be recovered using conventional Optical Sorters and / or other Plastic Recognition Technologies.

Rubber Tires and/ or Large Plastic Furniture materials can be recovered either at the pre-processing separation stations, or at the Oversize Overflow coming out of the organic fiber vibrator or trommel separators.

What to do Next... Does the Solution Solves All the MSW related Problems?

As it has been addressed on this presentation, local communities must assume responsibility over the disposal method selected to resolve all problems created by the MSW their community presently generates.

1. The MSW disposal method selected “Must” provide a ***Positive Environmental Impact***, thus protecting “Our Environment” for our present and future generations, addressing all polluting sources and elements known, as well as addressing important issues such as the “Green-House-Effect”, “Water Conservation and Aquifer Contamination”, “Degradation or Destruction of local Fauna and Flora”, among others. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

2. The MSW disposal method selected “Must” ***Effectively reduce MSW “Weight Quantities” Below specific Targets*** that any national, state and/or local regulation might have set to drastically reduce the MSW quantities presently being disposed of in their permitted landfills. National, State and Local Legislations must establish Financial Incentives as well as Fines associated with specific incremental target reductions and dates. These actions are aimed to increase the participation of private business in achieving positive and permanent solutions to the MSW disposal, resulting in “win-win” situations benefitting the whole community. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

3. The MSW disposal method selected “Must” ***Allow the Mechanical Recovery of Useful and Marketable Materials in MSW***, therefore reducing their recovery cost, and increasing their viable marketability. The recovery of these materials, mostly metals and plastic, is directly related to a “Carbon Positive Footprint”, therefore the establishment of Carbon Trade Markets by many countries have created great business incentives associated with material Recyclates from MSW. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

4. The MSW disposal method selected “Must” ***Allow the Mechanical Recovery of Energy Valuable Materials in MSW***, therefore reducing their recovery cost, and increasing their viable use in the generation of environmentally friendly clean energies. The recovery of these components, mostly organic and plastic materials without market value, is directly related to legislated financial incentives and fines associated with each progressive MSW percentile reduction target, and/or “0” Landfill Policy, establishing specific dates triggering these financial incentives and fines. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

5. The MSW disposal method selected “Must” assure that any ***Residual materials to be landfill must NOT be Toxic, Polluting or Hazardous***, therefore allowing its deposit in permitted landfills without any possibility to pollute any aquifer in the event of a liner leak or failure. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

6. The MSW disposal method selected “Must” be ***Capable of Expanding Processing Capabilities as Population Grows***, therefore providing the options to the local community and government to plan its growth without affecting or losing its initial or present investment. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

7. The MSW disposal method selected “Must” be ***Capable of operating in Privately or Publicly Owned Facilities***, therefore allowing any community the control of its own destiny, determining whether they want to develop and own a Processing and Material Recovery Facility (PMRF) and lease the operation with a private firm, or contract their generated MSW to be delivered to a privately developed, owned and operated PMRF, prior to a non-recoverable MSW disposal into their local landfill. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

8. The MSW disposal method selected “Must” be Financially Viable NOT increasing Tax Liability. ***The T&B Fabrication Rotoclave® allows Compliance with this requirement.***

Political Leaders, Environmentalists, Economists, the Scientific Community, and the General Population are all in agreement that it is necessary to implement a “Practical and Economic” method for the recovery of the great majority of reusable materials contained in today MSW. ***The T&B Fabrication Rotoclave® provides you NOW with that Permanent Solution to your MSW Disposal Dilemma, fully complying with the Required Benefits of Environmental Conformity and Financial Viability.***



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