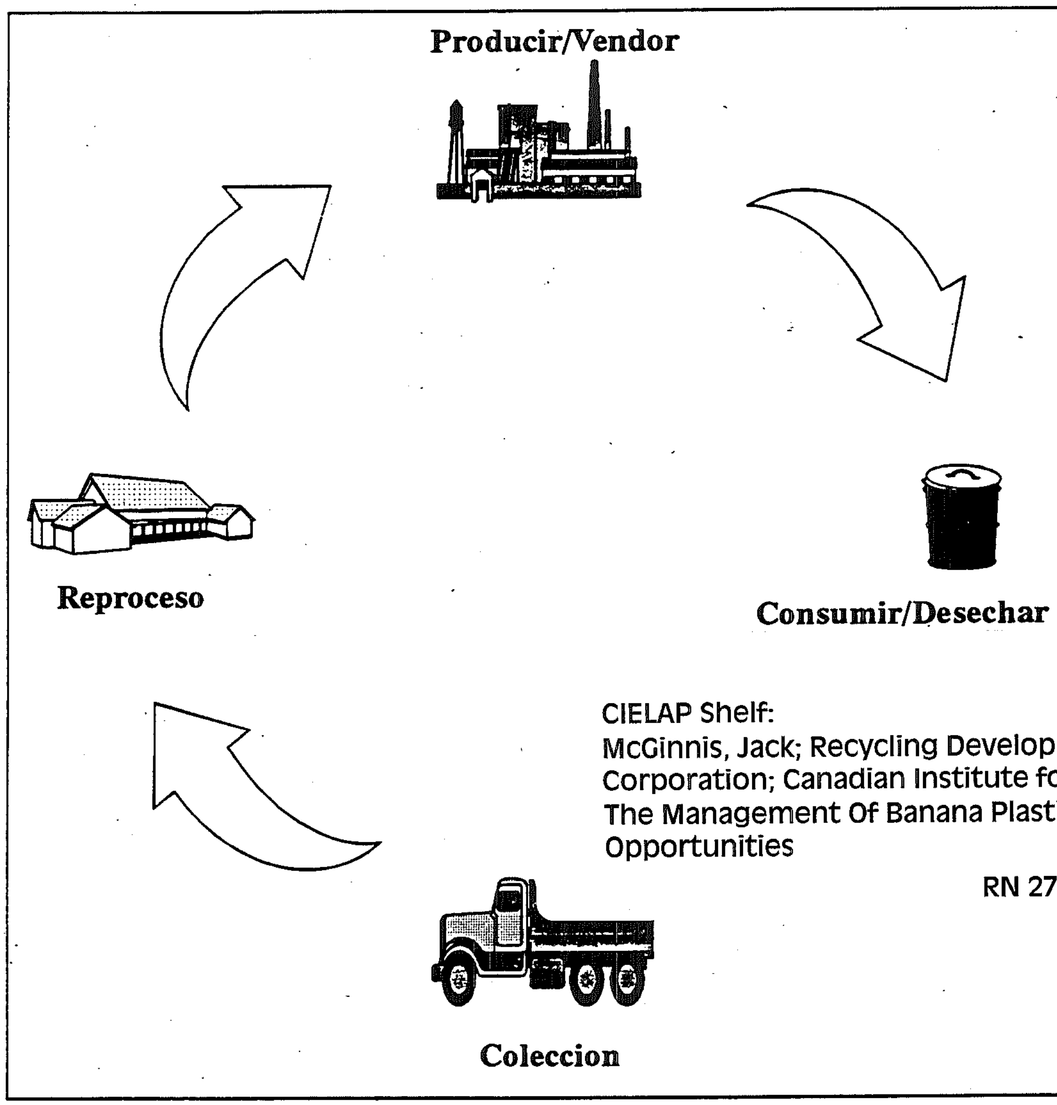
THE MANAGEMENT OF BANANA PLASTICS: BARRIERS & OPPORTUNITIES



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1.0 Introduction

1.1 Purpose of this Report

This Report contains the results of research and development efforts conducted during the past two months, particularly in the period of May 15th to May 28th, when the author was working in Costa Rica. In this two-week period there were numerous meetings and discussions undertaken with:

- Government officials, especially Ministry of Health staff;
- Investigators from the Laboratorio de Polimeros, Departamento de Quimica, Universidad Nacional (Poli Una);
- Officials from Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH;
- Representatives from Fundacion Ambio and ECO-OK;
- Business leaders in banana production; and,
- Business leaders in recycling and plastics manufacturing.

Full details of these consultations are provided in Appendix A.

This Report provides background information, conclusions and recommendations. This is based mainly on the Author's recent research and analysis, but also uses related research conducted over the past year by other consultants (please see Section 1.2 for more detail).

The primary focus of the report is on management options for waste plastics generated by banana plantations in Costa Rica. This involves discarded banana bags, made from low density polyethylene film, and discarded polypropylene cord. Secondary consideration is given to empty agri-chemical containers, mostly composed of rigid HDPE.

There is also some attention given in this Report to larger issues which may impact on both the economic and technical success of a management program for these "banana plastics". The subjects, addressed in Sections 4.0 and 7.0 in particular, include:

- The role of national and international regulations and trade practices; and,

- Possible beneficial links between banana plastics and larger solid waste management programs (particularly, waste reduction, reuse and recycling).

Despite referring to these larger issues, the primary objective of this Report is still to provide useful guidance for the development of practical programs which can result in a reduction in the amount of plastics discarded on fields or in landfills in Costa Rica. In this regard, there is a significant focus on existing barriers and possible solutions in markets, in Costa Rica and abroad, for products manufactured from recycled banana plastics.

1.2 Previous Research

There have been two research projects carried out over the past year which have direct relevance to this Report:

- June 1993 - Dr. Daryl Ditz, World Resource Institute
- March 1994 - Dipl. Phys. Jurgen Giegrich,

This research has provided important information to the Author for this Report. These efforts are described briefly in the following sections.

1.2.1 Ditz: World Resource Institute, Washington, D.C.

Following several days of tours of relevant facilities, meetings with key officials and a review of relevant literature, Dr. Ditz produced an overview analysis of the two main options he saw for the management of waste plastics - incineration and recycling. Some attention was also given to reduction.

The Ditz report (June 1993) provided recommendations for further research and development. It did not provide a final conclusion or recommendation regarding the choice between incineration and recycling as a management option. The report did, however, provide a clear picture of current waste management practices at many banana plantations in Costa Rica. It also identified many issues requiring further consideration in order to eventually reach final conclusions and recommendations.

1.2.2 Giegrich: Instituto de Investigacion Energia y Medio Ambiente, Heidelberg, Alemania

Only the preliminary results of the Giegrich report were available at the time that this report was being written. It was therefore difficult for this second research effort to be utilized to the same extent as the Ditz work.

Giegrich did identify concerns regarding incineration of waste banana plastics, but did not appear to rule out this option completely. While he agreed with Ditz that reuse was an unlikely alternative, and recycling was still seen as the most desirable management method for banana plastics, Giegrich did not - at least in his preliminary report - provide final solutions or recommendations for proceeding with a recycling development program.

2.0 Overview of Major Options and Issues

Over the past year the primary focus of research and development regarding plastic wastes from banana production has been on two options, i.e.: incineration and recycling. Details regarding these waste management approaches are presented in Sections 2.1 and 2.2.

In the case of recycling, there has been a connected, although secondary, focus on reduction and reuse alternatives. This information appears in Sections 2.2.1 and 2.2.2.

Information is also included in this Report on a third alternative - pyrolysis. While this technology bears some resemblance to the incineration option, it is fundamentally different from a traditional combustion process. Further details are included in Section 2.3.

2.1 Incineration

Significant detail regarding this option has been included in the two previous reports (Ditz - 1993; Giegrich - 1994) and will not be repeated in this Report.

The Author reviewed these reports, and also conducted a review of recent literature, mainly North American and European, on the subject of solid waste incineration. It was clear from this review that the scale of incinerator proposed by industry representatives would be subject to the following two significant problems:

- Difficulty in achieving and maintaining adequate air emissions standards; and,
- The probability that capital and operating costs would be too high in comparison to other alternatives.

These two problems are somewhat interconnected. The equipment required to achieve reasonable air emissions standards is quite expensive, given the size of the proposed facility. The capital cost of equipment utilized solely for air cleaning and controls could add as much as $1 million (U.S.) to the cost of an incinerator. Additionally, the operating costs associated with an effective monitoring program would also add significant expense to the costs incurred by both the facility operator and the Ministry of Health.

If recycling banana plastics can be developed so that this option becomes cost-effective for all parties, then it does not seem necessary to give further consideration to incineration.

2.2 Recycling

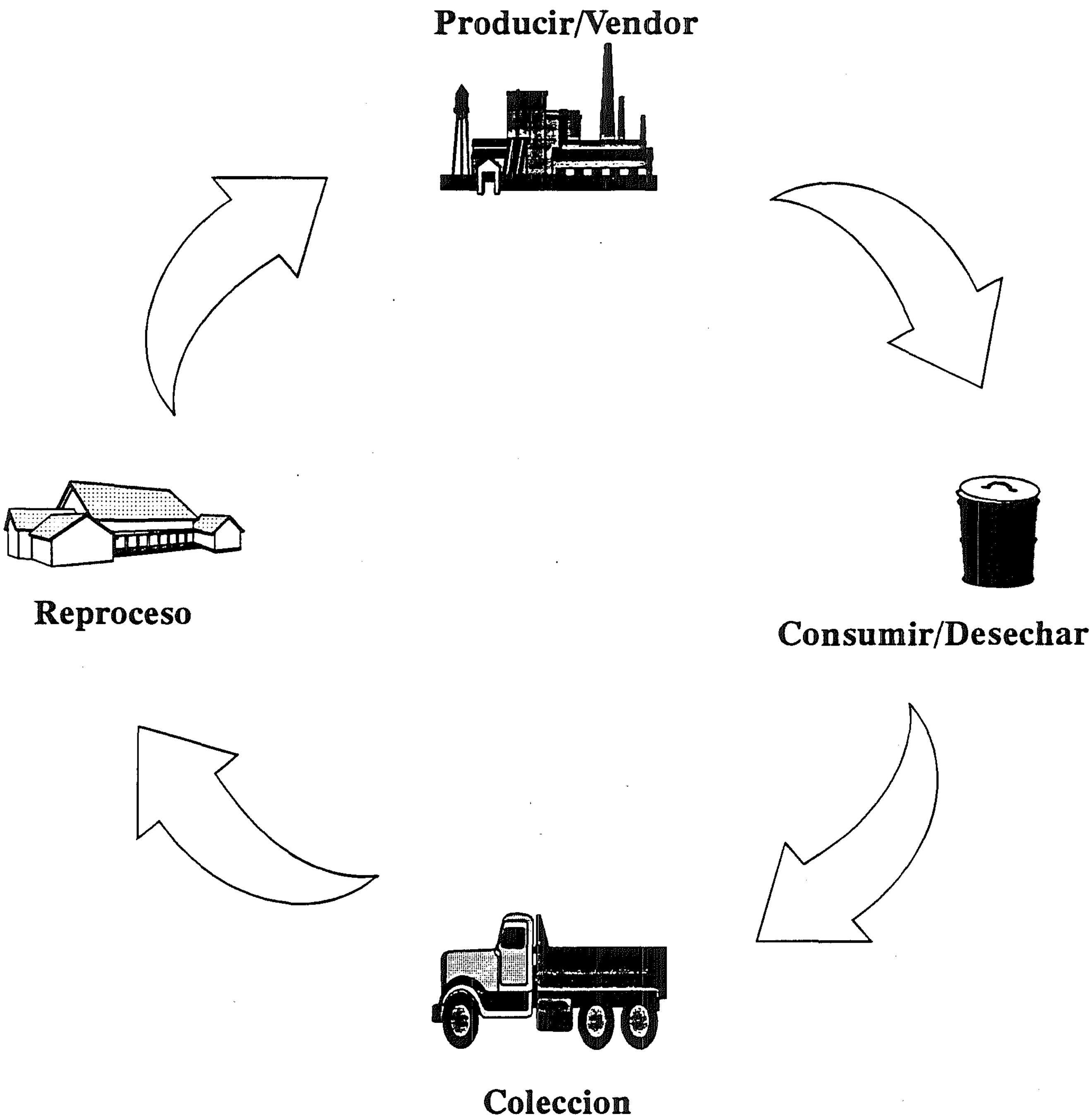
The word "recycling" is often used to describe one or another of several separate functions. For example, if someone separates a material from their regular waste they say that they are "recycling". In fact, they are performing one step in a much larger recycling process.

The full process - the series of individual functions that connect to complete the recycling "circle" - is illustrated on the following page. This process must include each of the individual steps in order for recycling to actually occur. If we simply collect a material such as plastic, and then don't use it in the manufacturing of a product, we have not completed the recycling loop. Also, if we make a product out of a recovered waste material, and then fail to market this product, we again have failed to complete the recycling loop.

In the research carried out for this Report there was attention given to each of the separate components of the full recycling process. Discussions were held with people involved with one or more of the following steps:

- Separating discarded plastics from other wastes
- Collecting, handling and transporting recovered material
- Reprocessing at a central facility
- Manufacturing of a product; marketing of this product

There are significant issues raised at each of the points identified in this summary. These are addressed in more detail later in this Report, particularly in Section 3.0.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2.2.1 Reduction

A reduction in the amount of plastic utilized in banana production represents the ideal solution since it not only reduces the size of the waste management problem, but also leads to a reduction in operating costs - assuming that all other operational factors remain constant, while the amount of plastic purchases for use in production is reduced.

The research carried out by the Author for this Report indicates that all the feasible reduction options are already in place. This has resulted from diligent efforts by banana producers to use banana bags that are "cut to proper length", rather than used in a standard size/length. In discussions with producers it became apparent that they have already achieved a 20% reduction in the amount of polyethylene film plastic. While there may be some additional minor reductions which could be achieved through better management procedures, mainly with polypropylene cord, this area is not viewed as being significant for the purposes of this Report.

2.2.2 Reuse

There are a number of technical barriers, including those identified in the Ditz report (June 1993) which work against the adoption of reusable methods for banana bags and the polypropylene cords used in banana production. This area is therefore not seen as holding any significant potential, for the purposes of this Report.

2.3 Pyrolysis

This third option has not been addressed in previous research, or by the business and government representatives who have been involved in banana plastics development over the past year. It has been included by the Author for discussion because pyrolysis technologies have, by design, fewer problems with air pollution since they operate with an oxygen-starved environment, with no "open-burning".

Pyrolysis technologies have been in development for about 20 years in various countries, but have only recently begun to enter commercial usage - mainly in North America. They have received particular attention as a management option for waste tires, since they provide a means by which an old tire can be broken down into valuable constituent parts, like oil products.

Information is provided in Appendix C which describes a commercial pyrolysis facility that might be technically and economically suitable for the management of banana plastics in Costa Rica. Cost and operating figures are provided for an example system from Conrad Industries, a U.S. supplier.

In brief, this type of facility would transform each kilogram of polyethylene or polypropylene into 800 grams of petrochemical product, equivalent to bunker oil (i.e., #6 heating oil). This bunker oil can then, if desired, be further refined to produce, for example, gasoline.

Assuming that 5,000 tonnes of banana plastics were processed each year in a pyrolysis facility, the main product would be bunker oil - approximately 1,000,000 gallons per year. In comparison, an incinerator with an "energy recovery" component which was also processing 5,000 tonnes/plastic/year could produce steam at the level of about 35 million pounds/year - the equivalent of between 1 to 2 megawatts of power, if converted (via a turbine) to electricity. However, this transformation - from plastic (via incineration) to steam, to electricity (via a turbine generator) - would be very expensive, given the significant capital equipment required. The "plastic to bunker oil" transformation would all occur directly within the pyrolysis process.

Costa Rica is a net importer of petrochemical products. Based on data supplied by Poli Una investigators, the difference between production and consumption in 1990 was about 2.6 million barrels. The most significant gap, however, was not in "bunker oil" but in diesel fuel. Still, a pyrolysis plant could make a modest contribution to closing the overall gap.

Further research would be required to determine if a pyrolysis facility would be feasible. It is recommended that this option be kept in mind, in the event that the recycling option does not prove to be feasible. If recycling cannot be implemented, then pyrolysis should be considered further, as an alternative to a more traditional incineration approach.

3.0 Barriers to Recycling

There are several significant barriers which are currently working to limit the development of a successful banana plastics recycling program in Costa Rica. These barriers can best be understood by referring to the key segments of the recycling process, as outlined in the previous illustration (Section 2.2). In this illustration, the following key points in the process were identified:

1. Separating discarded plastics from other wastes

2. Collecting, handling and transporting recovered material

3. Reprocessing at a central facility

4. Manufacturing of a product; marketing of this product

While **Step 1** does not present any technical barriers, there are costs that arise - i.e., from the additional labour required to carry out the separation at the plantation.

Step 2 is also an operational, cost issue, rather than a technical concern.

In **Step 3** there are no significant problems, other than the costs arising from reprocessing, which contribute to overall recycling system costs. In fact, there are a number of reprocessing businesses already operating, or prepared to begin operations when certain conditions are achieved (e.g., Plastipack, Recyplast, Barriplast).

The most significant barriers arise in **Step 4**, not with manufacturing, but with markets. This is not a surprise, since the lack of suitable markets is the most common barrier affecting recycling development for any waste material. Also, this problem occurs in every country that attempts to establish or expand their recycling infrastructure.

The significant barriers identified here are discussed in more detail in the following sections. They are organized in this discussion into three new categories, i.e.: contamination; operations/costs; and, markets.

3.1 Contamination

Contamination of different types affect the feasibility of recycling banana plastics, both the banana bags and cord.

Banana bags (polyethylene film plastic) are manufactured with various additives. Therefore, rather than just polyethylene, this material includes substances such as: UV stabilizers, colorants, plasticizers, and pesticides. It is this last additive - in the form of Dursban (the Dow Chemical brand used by many if not all manufacturers) - which raises the most significant concern. In one typical system, Dursban is initially mixed at a 5% ratio, dropping to 2.5% during extrusion and eventually to about 1% following distribution. Apparently this percentage is further reduced during the 14 week period in which the film plastic is being utilized in the field, but there is clearly still a large enough presence of this organo-phosphate chemical to be a concern in a recycling process. The presence of small amounts of Dursban would render recycled plastic unsuitable for products such as food and beverage containers, and even plastic pipe which might be used to carry drinking water. Thus, the presence of the pesticide will limit the variety of markets which can be considered for use of the recycled plastic.

Cord (polypropylene strapping) is not manufactured with any of the additives mentioned above. However, this material tends to become contaminated with dirt and other materials through its use in the field, and through its separation and recovery from field operations. Unlike banana bags, the cord is not automatically conveyed to a central point, such as the production area of a plantation, in a relatively clean form. It instead must be gathered in the field, a process which results in the type of contamination mentioned above. While this does not present a highly complex (i.e., "chemical") problem for recycling, it does indicate the need for washing to be part of the reprocessing facility. While not complicated, this step can lead to increased costs, and increased use of water at the recycling facility.

While they complicate the larger recycling process, both of these contamination problems can be overcome.

- Each step of the recycling process must be designed to minimize contamination;
- Certain measures - such as washing - may be required in order to address the contamination which does occur;
- Selection of production techniques and products must be made with any significant limits - such as the presence of Dursban - in mind.

It is important to stress the phrase "each step of the recycling process". By following common sense and careful design it may be possible to eliminate more difficult problems later in the process.

For example, when banana bags are separated from the pinzote at the plantation's production facility, they are placed into plastic bags for storage, prior to collection for transport to a central recycling facility. The simple act of tying these storage bags tightly can prevent water and other potential contaminants from entering the process. By eliminating this source of contamination, the need to address the problem through potentially complicated or expensive actions will be avoided.

3.2 Operations/Costs

The various actions required to establish an effective recycling system will require changes in the traditional banana production system - changes that may result in increased labour and/or other operating costs. This fact alone does not necessarily mean that "recycling is too expensive", since there may be cost-savings or program revenues which more than offset additional costs. Still, it is certainly important for operational changes and additional costs to be understood fully, and for any negative impacts to be minimized.

Each step in the recycling process that has been described - from separation, through collection and reprocessing, to final manufacture of a marketable product - has operational and cost implications. This does not have to function as a barrier which prevents recycling from being developed successfully, as long as the resulting material can be marketed, at a value sufficient to offset such changes and costs.

The first step - separation and recovery of waste plastics at the plantation - does not appear to be a major cost issue. There may, however, still be a need for some capital expense for compaction/baling/densification of some sort, to facilitate the cost-effective transportation of banana plastics to the central reprocessing facilities that are now or will be established.

The majority of the overall recycling system costs will result from collection and reprocessing into a marketable raw form (such as pellets). Cost estimates for this component ranged, in the Author's research and discussions, from $0.20 to $0.28 (U.S.) per kilogram. Assuming that additional components add to this cost, perhaps a reasonable total system estimate will be $0.30 to $0.50 (U.S.) per kilogram. While this cost may seem high, it is very reasonable if it results in a product (pelletized resin) which can displace the virgin resin now being imported at a cost of $0.60 to $1.20 per kilogram.

Therefore, the current view that operational change requirements and related costs are significant barriers may be overcome by a total system cost-benefit analysis, if adequate markets are secured for products manufactured from banana plastics.

3.3 Markets

Throughout most of the Author's discussions with business and government representatives, the word "markets" was at the centre of most comments regarding barriers. While the lack of adequate markets is not the only problem, it is certainly viewed as the most serious.

It is important to understand that the issue of "markets" is not isolated - it has links to the other components in the full process ("circle") of recycling. As mentioned in Section 3.1, the extent to which a material contains certain contaminants will have a direct impact on the marketability of products produced from that material. There is also, as mentioned earlier, a link between the revenue level required of a product/market and the costs incurred in producing that product.

However, the market problem can also be defined in a more direct, narrow manner. Simply put, there are two aspects: there are not enough people/businesses interested in buying recycled plastics; or, those who are buying recycled resin are not paying a high enough price to offset operating costs.

Given the importance of markets to the success of banana plastics recycling, this subject has been addressed in much more detail later in this Report. Section 4.0 addresses the global and regional trends affecting market development for recycled products. Section 5.0 addresses specific market opportunities in Costa Rica and other countries.

4.0 Relevant Global Trends (Europe and North America)

Over the past 5 years the growing concern for environmental protection has resulted in the adoption of dozens of new national laws and international trade agreements, particularly in Europe and North America. Many of these regulations have been designed to specifically address the recovery, recycling and marketing of materials like plastics from banana production. Therefore, these global trends and the beneficial role which they might play in Costa Rica should be examined.

Two types of regulations are addressed in this Report:

- National laws requiring businesses to adopt new recycling practices;
- National laws which affect economic decisions (in particular, market development).

The primary purpose in reviewing examples of these types of new regulations is to identify areas where developments in certain countries might result in market opportunities for products from recycled banana plastics. A secondary purpose might be served by consideration of similar regulations being adopted nationally in Costa Rica.

4.1 National Laws Requiring Businesses to Adopt New Recycling Practices

While there are many recent examples of these types of laws, the examples used here are both from Canada. These two case studies are representative of similar regulations adopted by various countries in Europe and individual states in the United States. In the U.S. there are a number of laws currently under consideration at the national level, but have not yet been adopted by the U.S. Congress.

4.1.1 Federal Initiative: National Packaging Protocol (NAPP)

In 1990, the Canadian Federal Government released the National Packaging Protocol (NAPP) to encourage private companies to reduce their packaging waste and the environmental effects associated with this waste. Although backdrop regulations have been created for use in the event that compliance is not achieved, this is mainly a voluntary measure. The protocol's targets are to reduce packaging waste across Canada by 20% by the year 1992, 35% by 1996, and 50% by the year 2000, compared to the base year of 1988.

The Protocol applies to all packaging used in Canada, regardless of its country of origin. Therefore, if packaging is produced in Europe (or Costa Rica) and is imported to Canada, it is expected that the importer will work with the producer to encourage the producer to practice the concepts of reduce, reuse and recycle.

A packaging audit has been designed for use by those packagers, manufacturers or importers to assist in calculating the percentage of packaging reduction that they have achieved.

Adoption of the National Packaging Protocol has begun to result in changes in packaging. Some companies have "lightweighted" their packages (reduced the weight or thickness); others have eliminated part of their packaging altogether. Still others have changed packaging design, to support recycling. The Protocol is expected to continue affecting the business decisions of packaging manufacturers and purchasers in future years, heading towards the 50% reduction goal in the Year 2000.

4.1.2 Provincial Initiative: 3Rs Regulations

On March 3, 1994, the Ontario government adopted the 3Rs Regulations. These regulations apply to non-hazardous solid waste produced in both municipalities and the industrial, commercial and institutional sectors. These regulations require various actions, including the following:

- all municipalities of a certain size must provide residential recycling and backyard composting programs.
- all industrial, commercial and institutional (IC&I) waste generators of a certain size and type must prepare and implement a waste audit and workplan.

- all manufacturers, packagers and importers of a certain size must prepare and implement a packaging audit and packaging reduction workplan.
- all IC&I waste generators of a certain size must implement recycling programs for specified materials (e.g., paper, glass, metal, plastic).

The packaging audit required by the Government of Ontario was designed to complement the National Packaging Protocol.

As a result of these 3Rs Regulations, a new "Green Industry" is being created in Canada. There are now companies who are solely in the business of conducting "waste audits", and others who now specialize in providing recycling and composting services. Step by step, major changes are taking place in the way that many businesses operate.

4.2 National Laws Which Affect Economic Decisions

Over the past several years there have been a number of new laws adopted, mainly in Europe and mainly related to environmental responsibilities for businesses who produce or utilize packaging. The trend in type of regulations is one of "product stewardship". Generally, product stewardship is the concept in which those responsible for actually producing the waste product are also responsible for the eliminating or reducing the impact of this waste. The most publicized of these regulations has been the "Green Dot" (Der Grune Punkt) law in Germany.

4.2.1 Der Grune Punkt (the "Green Dot")

In 1990, the German Government introduced legislation designed to enforce the recycling of all packaging, including that originating from importers. This legislation allows consumers to return empty packages to stores, making the retailer responsible for the proper disposal of the package. The companies that fill the packages with product responded by creating an alternate system that was equally acceptable to the government.

The resulting "Duales System" promises that any industry member bearing the "Duales System Deutschland" symbol - the Green Dot - will have their package recycled. Funded through the membership fees for the Green Dot symbol, the collection system that has been created involves direct pick-up from houses and stores, and drop-off at numerous recycling depots.

At about the same time as the German system was being introduced, the French Government introduced Eco-Emballage. This national law is very similar to the Green Dot, although not identical. There are now many similar laws - adopted or planned - in most European countries. Also, the European Economic Community has been working for two years to develop a single, standard law for all countries to follow.

Since 100% of the cost of the Green Dot recycling system is paid by packaging producers and users, they have a strong and direct incentive to make the system more cost-effective. This point was strengthened a year after implementation when "differential pricing" was introduced to guide the fees paid for use of the Green Dot. Rather than paying a standard fee, companies now pay according to the actual cost of recycling their package - for example:

Glass	160/DM per tonne
Paperboard	330/DM per tonne
Steel	560/DM per tonne
Plastic	2,610/DM per tonne

This means that a company which shifts from plastic to paperboard can reduce their "membership fees" significantly. Further, if a company manages to eliminate some packaging totally, they then pay no fee at all.

Research carried out during 1993 has shown that hundreds of changes in packaging usage have been made as a result of this new law. These changes have included:

- design changes to support recycling;
- an increased use of recyclable packaging;
- increased purchase of recycled materials;
- shifts from high cost to low cost packaging (i.e., based on the fee schedule shown above); and,
- decreased use of composite packaging.

There have also been problems with the German law. For example, markets for recovered plastics were quickly filled and material was either put into storage or shipped to other countries. There is also still some concern on the part of businesses and the public about the total cost of the program - a cost that is naturally being passed along to consumers in the price of the products that they buy. Other countries, including the U.S., have therefore looked at the German law as a learning model, and are planning to adopt their own version, designed to work better in their own country.

4.3 Recent Technological Developments

The global move towards environmental protection and sustainable development has already resulted in new technological developments, as businesses search for more cost-effective methods by which they can carry out their new responsibilities.
Some of these new developments are directly relevant to the field of plastics recycling, and even the specific area of banana plastics recycling. Some examples are discussed in the following sections.

4.3.1 Collection

The first specialized waste collection system and equipment was developed during the 1950's - compactor trucks, front-end loading bins and trucks, and so forth. A similar development began to occur during the 1970's, as recycling programs became more common and manufacturers began to experiment with specialized equipment.

There are now nearly as many companies manufacturing specialized equipment for recycling as for traditional waste collection and disposal. Examples would include: compartmentalized collection trucks; mobile and stationary compactors and balers; mobile "truck-mounted" shredding equipment; and, many different types of bins and containers for use in recycling collection, including wheeled carts ranging from 10 litres to several hundred litres in size. Details regarding the many different types of equipment and the many different suppliers have not been included in this Report, but can be provided if required.

Partly as a result of the availability of this new equipment, the per tonne cost of recycling collection has dropped significantly in recent years.

4.3.2 Reprocessing

Over the past 10 years there has been a significant amount of research and development work to address the specialized equipment required to assist in the key "reprocessing" step in the middle of the full recycling process. In the area of plastics recycling this work has been focused mainly on the development of new equipment for the sorting, washing, and densification (via extrusion or compression) of waste plastics.

Some examples of these new reprocessing systems are already being used in Costa

Rica - for example, the compression equipment now utilized at Plastipack (Grupo Polymer) and the extrusion equipment utilized at Barriplast.

A fully modern reprocessing facility would have more components than the examples now operating at the facilities examined during this project. Assuming that the final "product" desired was a marketable pellet, and that the recovered waste plastic had a significant level of contamination, the following process line and components might be required:

- prewashing
- grinding
- washing (drying)
- extrusion

This type of facility could, with relatively minor additions, move beyond pellets to the extrusion of an actual product, such as a plastic pipe or other building product. However, the final product desired might be one which requires either blow moulding or hydraulic compression. The first method would be utilized if the desired product was, for example, a plastic box. The second method would possibly be used if the desired product was a form of "plastic wood" (e.g., the "walk-way" boards being produced by Plastipack).

Appendix B contains detailed information on one of the most advanced reprocessing systems currently available - the Sorema Plastics Recycling System from Italy. This plant was sized on request to handle 5,000 to 7,000 tonnes/year of LDPE film and PP cord. The installed cost (less land and building) was quoted at 2.5 million DM. This plant could also handle rigid HDPE containers (e.g., from agri-chemicals).

Sorema has over 100 such plants in operation around the world, including some which handle banana bags and other waste from banana plantations.

4.3.3 Products and Markets

There are a very large number of new products and markets that have developed in the past 10 years, mainly as a result of the overall growth in recycling around the world. Innovative new technologies have been developed to produce particular products from recycled materials; equally innovative methods have been used to identify and/or create market demand for such products.

The following case study is presented, since it describes a particular technological advance that may be of direct relevance to banana plastics in Costa Rica.

Case Study: Bag Extrusion from Recovered Film Plastic

The modern "garbage bag" was first developed in Canada in the 1950's. In the mid to late 1980's the first "recycling bags" (and composting bags) were also pioneered in Canada.

One of North America's most popular brands of garbage bag is the Glad Bag, originally developed by Union Carbide more than 30 years ago. This product is now marketed by the First Brands Corporation in Canada and the U.S.

When First Brands first started planning their new product line they realized that it would be a major benefit if they could offer to "take back" all recycling and composting bags sold so that the bags themselves could also be recycled. Further, they realized that it would be a marketing advantage if they could produce their specialized recycling/composting bags using some percentage of recovered waste plastic.

Starting in 1987, First Brands began addressing a variety of new technical challenges in this marketing effort. While this entire project was interesting, our concern here is the specific challenge of manufacturing new plastic bags using a significant amount of old plastic bags.

The biggest challenge in this area came from the composting bags, which were highly contaminated following their use to hold wet food and yard waste. Following many unsuccessful trials, First Brands eventually achieved successful production of a high quality plastic bag containing 50% recycled content (and 50% virgin resin). Key steps were:

- Initial resin formulation carried out with eventual reprocessing/recycling in mind;
- An effective washing system for recovered film plastic;
- A re-melt process which minimizes the heat required, using only enough to reach the required melt temperature;
- Trial and error testing, using existing equipment, to achieve a successful extrusion protocol.

This research and development experience spanned several years, and has resulted in a valuable commercial advantage for the First Brands Corporation. In recent discussions with their senior technical staff, they have agreed to share their learning and experience if it will be helpful to operators within Costa Rica who wish to extrude new plastic bags from recovered film plastic.

5.0 Products and Potential Markets

5.1 General Overview

Market development opportunities for recycled products manufactured from banana plastics do exist, but some effort will be required to connect the supply to the most appropriate type of demand for this waste material.

The evaluation and market potential, and the efforts to carry out actual market development, should follow a hierarchy of possible solutions. In other words, it is suggested that further planning should follow a particular order of priorities, i.e.:

1. Markets within Costa Rica, involving a "closed-loop" (e.g., recovered banana bags used to produce new film plastic, particularly for banana bags);

2. Markets within Costa Rica, not involving a "closed-loop" (e.g., plastic building materials);

3. Markets outside of Costa Rica.

Of course this order of priorities will be preferred only if other key factors are equal. If, for example, there is greater security of demand or a higher value associated with a market outside of Costa Rica, then this market will be preferred over a less stable or less valuable market within the country.

When dealing with the third priority - external markets - there are two different types of potential opportunities that exist, i.e.:

- Markets driven mainly by the purely commercial value of the product (e.g., a floor tile that is simply competitive, in quality and price, with a similar product made from virgin material);

- Markets driven by other factors, such as the desire of a large corporation to indicate that they are using a recycled product from Costa Rica, because this will enhance their corporate image.

More information regarding the list of three market development priorities, and these two different types of "external" market opportunities, is provided in the following sections.

5.2 Specific Market Potential Within Costa Rica

Several examples of "internal" market opportunities are described here, in some detail. Some additional examples are identified, without elaboration, in the Appendices.

5.2.1 Film Plastic Products - Banana Bags

In Section 4.3.3, some detail was provided regarding recent technological advances in Canada in the extrusion of plastic bags from resin containing recovered waste plastics. The technical details will not be repeated here.

Further analysis (and testing) could demonstrate that it is possible to produce quality banana bags from recovered film plastic (LLDPE). One point in particular makes this is worthwhile objective, i.e.:

- The retention of organo-phosphates (e.g., Dursban) in the reprocessed plastic, which can be a significant problem for some products (e.g., plastic pipe) could be neutral - or even a benefit - in the production of new banana bags.

If all new banana bags used in Costa Rica could be produced with about 50% recycled content and 50% virgin content, this would create a market for most, if not all, of the old banana bags that could realistically be recovered. No recovery system will be able to achieve 100% recovery, or often even a level approaching 100%.

In the U.S., after spending years and millions of dollars, the aluminum industry is only now approaching 65% recovery of used aluminum beverage containers. Therefore, the achievement - and direct "closed-loop" recycling - of 50% of all banana bags used in banana production would be a reasonable initial goal.

This would also mean that the quality of banana bags being manufactured would not be in jeopardy, since there would always be an input of new resin into the system. In other words, the film plastic loop would be replenished to ensure that quality (i.e., integrity of the polymers) could be maintained.

5.2.2 Construction & Building Products

There are a number of potential market opportunities in the area of construction and building products. There is, however, one particular case which might indicate a unique type of market development potential.

In discussions with the Costa Rica - Canada Foundation there was clearly a strong interest in consideration of the potential for creating new market opportunities within the 1,800 homes that the Foundation helps to build each year.

For other reasons this agency has already begun to evaluate the potential for using new building materials which are manufactured from waste plastic. One of the most promising potential products cannot be publicized at this time, due to the proprietary interests that are involved. However, there is a second example which illustrates the same point.

The baseboards which are currently used in most housing construction are manufactured from a polymer. This product could be manufactured from a mixture of LDPE and PP, with no loss in quality or function within a house. Further, the concern regarding contamination would not matter with this product, since no chemicals would be expected to leach out of a baseboard, under any expected circumstances.

Some additional information regarding products of this type can be provided, if required.

5.2.3 Other Products

There are a variety of other products which can potentially be made using the "plastic wood" process described earlier (Section 4.3.2), or other methods (extrusion, blow-mould). One example, for which some testing and development has already taken place in Costa Rica, is shipping pallets.

In early tests there were some problems with the tendency of the plastic wood to bend under the weight of products being carried on the pallets. Plastic wood does not have the same structural integrity of the hard wood traditionally used in the manufacture of pallets.

Based on discussions with industry officials in Costa Rica there is some current work underway to redesign the construction of plastic pallets in order to overcome this problem. Another option would be to combine some plastic wood with some natural hard woods.

Since banana producers purchase and utilize pallets, they have some ability to influence their suppliers to consider use of a "recycled content" pallet.

Another example of a product that could have significant market potential within Costa Rica is a plastic tote, the kind which is increasingly being used by manufacturers in place of a cardboard box. This change is being adopted in North America by major businesses such as McDonald's Restaurants and Holiday Inn Hotels because they are finding use of a reusable shipping container, which can be used dozens of times, to be more economical than the purchase of dozens of cardboard boxes.

Many of the plastic totes now being marketed in North America are being manufactured from 50% or more recycled content. Also, manufacturers are highlighting this recycled content as a feature in their marketing campaigns.

One limit to this market opportunity may be the capital costs associated with the mould used to make these containers. Such a mould can cost in excess of $50,000 to purchase.

5.3 Specific Market Potential Outside of Costa Rica

In considering "external" market opportunities there are reasons to look first to potential products that can be sold within Central America. Transportation costs alone might make a more regional strategy more economic. However, the opportunities already discussed in Section 5.2 are probably the most relevant for a "regional" approach.

In this section the focus is on more distant markets, with particular attention to North America and Europe.

5.3.1 Construction & Building Products: North America

One reason for focusing on North America, essentially to sell the same kinds of products described in Section 5.2.2, is that the total market is larger by a factor of more than 50 to 1. But there are other, additional reasons.

North America has already begun to firmly adopt a "buy recycled" attitude. In the past several years there have actually been circumstances where recycled resin has become more valuable than virgin resin - because someone decided that customers would pay a premium to obtain a recycled product.

There is also a more established marketplace, with a material specification and pricing history, now operating in North America. With hundreds of businesses in this marketplace, many with years of practical experience, it tends to be easier to conduct business in a stable and predictable manner.

These trends and current marketplace realities can present some specific market opportunities, as discussed in the following case study.

Case Study: Halstead New England Corporation

The Halstead New England Corproation recycles PVC agricultural sheets in China, Taiwan and Malaysia. This plastic is originally used as a screen against weeds growing in the fields. Since the plastic is also impermeable to water, it is also used in sea-salt recovery. The salt residues and the dirt and pesticide contamination do not affect the recycling process.

The PVC is reprocessed into floor tiles, and are certified by Scientific Certification Systems (SCS), a non-biased certification system that considers all aspects of the production and use of a product before designating the product to be environmentally compatible. The finished floor tiles use 30% post-consumer PVC in their construction, and are sold at the major North American hardware store chain, Home Depot.

Partly due to their SCS identification, and partly due to the fact that the tile is one of the least expensive available, the market for this material is quite strong. It is estimated that the demand for recycled PVC is approximately twice what the recycling infrastructure can now provide.

5.3.2 Dedicated Supply of Product(s) to Specific Target Corporations

There are some unique marketing forces which have begun to drive demand for recycled materials and products. Some multi-national corporations, like McDonald's Restaurants, have realized that "green marketing" pays - i.e., by highlighting environmentally beneficial actions of a general nature, they can help sell specific, unrelated products like hamburgers.

McDonald's Restaurants recently announced a commitment to purchase $100 million in recycled products, as part of a corporate campaign to demonstrate environmental responsibility. At the same time McDonald's Restaurants of Canada announced a similar commitment, for a total of $10 million in "buy recycled" purchases.

A significant portion of this commitment will logically be filled by purchases of foodservice items containing recycled content. Examples would include take-out bags and napkins. However, McDonald's also regularly purchases plastic products, such as tables and chairs, and serving trays. It is possible that this corporation would be interested in a direct supply arrangement, particularly if it resulted in their ability to display the "ECO-O.K." or Rainforest Alliance logos.

Since McDonald's will be a target for many recycling operators, it may be necessary to follow a similar marketing strategy, but with another corporation. Since the forces driving demand by McDonald's, or a similar "high profile" corporation, do not result from traditional supply-demand issues, the most effective marketing strategy will likely also be unusual.

Traditionally you start by identifying a product, and then you look for a buyer. In this case, the search should start with the identification of an interested corporation - one which wants to enhance their overall environmental image by supporting a "buy recycled" program generally, or a specific recycling campaign in Costa Rica. Discussions with this corporation can then focus on the products that they already purchase, and the potential to replace one or more of these products with items made from banana plastics from Costa Rica.

The Author can work with interested parties in Costa Rica to help identify - and initiate discussions with - corporations who may be ideal targets for this marketing campaign. Further details are not included in this Report, but can be provided.

5.3.3 Analysis of European Market Potential

The primary focus of the market discussion in this Report has been on North American opportunities, rather than those in Europe. This is the case because, at this time, Europe does not represent a vast market potential.

The advent of new national laws like the Green Dot in Germany and Eco-Emballage in France has resulted in many positive benefits, but have also led to some temporary problems. The sudden growth in recovery of waste materials for recycling has tended to create an oversupply in markets, throughout Europe and beyond.

This is particularly true for plastics. Government and industry officials in Germany did not expect to see the high recovery levels that have been achieved for plastics in the past two years. Since incineration is not allowed under the German law, it has been necessary for large volumes of material to be exported - to England, France, Italy, and even to Malaysia.

In contrast, demand for recovered film plastics has risen to the point in eastern North America where buyers are considering importing some of the excess plastics from Europe to meet their demand.

While it is possible that this market situation could change in the next one or two years, at this time the main focus should not be on Europe, but on North America.

6.0 Conclusions and Recommendations

Following is a summary of the primary findings of recent research as outlined in this Report.

CONCLUSIONS

1. Recycling of banana plastics can be feasible - both technically and economically - if there is full cooperation and participation on the part of all government officials and industry leaders in Costa Rica.

2. Incineration does not provide a suitable solution, since air emissions controls and monitoring would be difficult and expensive, and overall costs would likely be too high, particularly if proper air quality standards are met.

3. If recycling is pursued successfully, it will not be necessary to give further consideration to incineration as an alternative.

4. If there are some needs which cannot be met by recycling, it is possible that a modern pyrolysis system will provide a better alternative than incineration, on both technical (particularly air quality) and economic grounds. Further evaluation is required, if an alternative is needed.

5. Significant market potential does exist for recovered banana plastics - within Costa Rica, and in other countries.

6. Assuming that the required market development work is successful, and reasonable revenues are achieved, the overall cost-benefit picture for recycling does appear favourable - i.e., costs of $0.30 to $0.50 per kilogram, versus replacement of resin valued at $0.60 to $1.20 per kilogram.

7. Much of the learning and development work carried out over the past year can be applied to larger solid waste issues in Costa Rica. In particular, a banana plastics recycling program might serve as a useful model for recycling of all solid wastes from cities and towns across the country.

Following is a summary of the specific recommendations that have resulted from the research outlined in this Report.

RECOMMENDATIONS

1. An Action Team should be formed, to include representatives from: the Ministry of Health; banana producers; plastics manufacturers; and recycling operators. This Team could also include Poli Una, as a technical resource, and other key institutions such as GTZ and Fundacion Ambio. This Action Team can help to create the cooperation and coordination that will be key to the success of recycling efforts.

2. A Common Action Plan should be adopted by the Action Team. A "draft for discussion" of such a Plan can be drawn from this Report and other research efforts carried out over the past year, possibly with guidance from GTZ (given the important coordinating role that this agency has already played).

3. The final steps of research and development required prior to full implementation should be completed, possibly with further financial and technical support from GTZ. These final research and development needs include:

   - The drafting of a common marketing strategy;
   - Further technical analysis of extrusion methods for production of banana bags utilizing some (e.g., 50%) recycled content (i.e., recovered film plastic);
   - Further analysis of requirements for successful manufacture of shipping pallets utilizing recycled content (LDPE, PP); and,
   - Initial contact with, and market development planning for, key corporate targets - e.g., McDonald's Restaurants, Home Depot. In this regard, there is also a need for initial analysis of possible products and the equipment/processes required for production.

4. The Action Team should proceed to negotiate an agreement to use the "ECO-O.K." and/or "Rainforest Alliance" logos, for products which support the Banana Amigo program. The benefits of this effort can include:

   - Direct, significant assistance in the marketing of wastes, like banana plastics, in external markets;

- Support for more awareness in other countries of the ECO-O.K. and Rainforest Alliance efforts - not just where bananas are sold, but in other markets also; and,

- The opportunity to serve as a model which can eventually be used for other waste recycling programs in Costa Rica.

5. Continue to carry out research and development efforts for the other materials, beyond LDPE film and PP cord, that are now discarded from banana production, including:

   - Further research into solutions for agri-chemical containers (mainly rigid HDPE);

   - Continued development of programs to utilize the organic wastes (e.g., pinzote processed into "banana paper"); and,

   - In the case of organics, the potential for energy production should be examined. Initial analysis indicates that there is about 100 MW of energy available through a "bio-gas" recovery system (the equivalent of a small nuclear plant).

6. The Action Team should initiate discussions with the National Government regarding the use of the "banana plastics recycling program" as a model for dealing with larger solid waste management (recycling) issues in Costa Rica. Action steps could include:

   - Sharing of information (reports, research results) gathered in this project over the past year; and,

   - The active participation of representatives from the National Government in meetings, discussions and workshops of the Action Team.

7.0 Implications for Larger Solid Waste Management (Recycling) Policies and Programs in Costa Rica

In Sections 4.0 and 5.0 of this Report there has been considerable discussion of global trends and new national laws that have been adopted in many countries over the past several years. The focus has, however, mainly been on consideration of how the "banana plastics recycling system" can benefit from the new regulations in other countries - particularly in terms of the increased market demand that is being created.

From a different perspective, there can also be consideration given to the benefits which might result from the adoption of similar laws and regulations here in Costa Rica. This subject is addressed briefly in the following sections.

7.1 Solid Waste From Municipalities

The current solid waste crisis in the San Jose region raises many issues which apply equally to all cities and towns in Costa Rica. How should solid waste collection and disposal be managed? Can recycling provide a solution? Who should pay for garbage, particularly for garbage recycling programs?

As outlined earlier in this Report, many countries are acting to change the way they manage solid waste in their municipalities. They are working to shift responsibility away from government and the public tax base towards the producers who make and use items like packaging and the consumers who purchase these disposable items.

There are many different legislative models which can be considered. Further detail will not be provided in this Report, since this is outside the scope of current research. However, there has been agreement that the Author will provide relevant information, separately, to the Ministry of Health so that they can consider these other policy and program options.

7.2 Solid Waste From Industrial, Commercial and Institutional (IC&I) Sources

While the solid waste produced by households is commonly viewed as a public responsibility, to a great extent, the waste from non-residential sources has often been assumed to be more of a private concern. However, such wastes will often still end up at the municipal landfill site, which means that government and the public end up dealing with the problem, to some extent.

For this reason it is reasonable to consider National policies and programs which set certain requirements for the industrial, commercial and institutional sources of solid waste. One example from Canada of such requirements has been outlined in Section 4.1 of this Report. There are other examples.

The current "banana plastics project" is already a good example of this kind of "good business responsibility" being adopted, in this case by banana producers and plastics manufacturers in Costa Rica. Consideration can be given to expanding this type of "good citizenship" to other businesses in Costa Rica. Again, other information in this regard will be provided by the Author to staff of the Ministry of Health.

7.3 National Policies and Programs

In closing, it is clear that efforts over the past year to address the plastic wastes from banana production would have been less complicated if there were already National policies and programs in place to deal with all solid waste management and recycling issues.

If such policies and programs are considered and eventually adopted, it will be easier to address the next problem that develops, whether it be hamburger production or the bottling and distribution of beverages. If clear policies and programs are adopted by the National Government, it will be much easier for many potential garbage problems to be transformed into business opportunities.

CONRAD INDUSTRIES, INC.

Founded 1955
Advanced Recycling Systems
Material Handling

WASTE MANAGEMENT/WASTE-TO-ENERGY

NARRATIVE SUMMARY OF EVENTS

In 1975, one of our commonly owned companies became involved in city and county solid waste collection and disposal contracts. This solid waste was taken to a landfill. Company management was totally against land filling, as a long term solution to dispose of waste materials. Management believed this municipal solid waste was actually a natural resource and to simply put it in a hole and cover it over with dirt was not being responsible to society today or in the future. This raised the question of how could we be more accountable for the abundant material things we enjoy.

With this concern in mind, management encouraged the project company of Conrad Industries, Inc. to seek out more effective ways of waste management and material recovery from waste. A project manager with solid waste management skills was hired in 1978 to research and develop new technology for Conrad Industries, Inc.

In 1979, Conrad Industries, Inc. began to seek solutions to the waste problems and became involved in waste management and waste-to-energy projects.

In parallel with this effort, an association was established with Kleenair Products Company in Portland, Oregon. This manufacturing company, founded in the mid-1920's, also had an interest in waste recovery and their background lent itself toward thermal decomposition of biomass products. The two companies embarked upon a joint effort to recover waste through the process of pyrolysis, the thermal decomposition of an organic feedstock such as biomass, under high temperatures and in the absence of oxygen.

Based on the potential market for pyrolysis systems, a 200 lb. per hour prototype system was built in 1980 and operated for one year. The main feedstock tested on this unit was x-ray film for the recovery of silver. This prototype system provided valuable information from an engineering perspective.

Conrad Industries, Inc. • 121 Melhart Road • Chehalis, WA, U.S.A. 98532 • (206) 748-4924 • FAX (206) 748-4535

Beginning in 1982, a small (400 lb. per hour) commercial model machine was constructed. We were able to add to our data base by testing various feedstocks. This production model machine, operating over a two-year period, successfully decomposed and generated by-products from wood, paper of all kinds, most types of plastic, municipal solid waste, rubber products, automobile fluff and hazardous waste consisting of solvents and paint sludges.

A near continuous six-month run was made on rubber products and the information gathered from these tests led to the construction of a commercial one ton per hour rubber tire chip feedstock system. The three by-products of oil, vapor gas and carbon were tested analytically in independent labs. This data was used to research the market place for potential buyers.

In March of 1986, Conrad Industries, Inc. dedicated a new commercial tire pyrolysis plant in Chehalis, Washington. This facility is capable of converting one ton of tire chips (90-100 tires) per hour into 600-650 pounds of carbon, two barrels of oil and 3,000 - 4,000 SCF of vapor gas. These by-products have commercial value and are sold.

In 1992, Conrad Industries, Inc. signed an agreement with the American Plastics Council (APC) to study, research and test various post-consumer plastic feedstocks in the Conrad/Kleenair advanced recycling unit. APC is a trade organization whose members are International Fortune 50 Companies such as Mobil, Exxon, Chevron, Amoco, DuPont, Dow Chemical, etc.

In 1993, Conrad Industries, Inc. signed a separate agreement with APC to modify Conrad's commercial unit to recycle both waste tires and post-consumer industrial plastics.

The 1992 and 1993 contracts with APC are the culmination of a worldwide search by APC for the most advanced recycling technology available. Consequently, APC settled in on the Conrad/Kleenair technology and committed to spending several million dollars on the units.

In 1994, Conrad Industries, Inc. is the first company in the world to operate two pyrolysis plants which handle entirely different feedstocks - tires and plastics. The facility has the capacity to process 14,400,000 lbs. of tires and 3,000,000 lbs. of plastic per year.

APPENDIX A:

Itinerary: May 15, 1994 to May 28, 1994

Appendix A

Details of Consultations & Site Activities

May 16: Initial meeting at GTZ, with Ing. Ana Villalobos and Ing. Andres Incer, Ministry of Health

Planning meeting at POLIUNA, with Dr. Manuel Moya, M.SC. Marlen Duran, and M.SC. Maria Rosario Sibaja.

May 17: Tour of Grupo Polymer plant in San Jose; discussions with Plant Manager and Wilberth Vasquez Bustos of the Ministry of Health.

May 18: Tour of Recyco plant; meeting with Ing. Diego Escorriola regarding market opportunities.

Meeting with Ing. Jose Rodriguez of Reciplast, and discussions with Sr. Rodriguez and Sr. Incer

Meeting with Nidia Morera, Ministry of Health, regarding agri-chemical containers

May 19: Meeting with M.SC. Lorena San Roman, Vicerrectoria de Investigacion, Universidad Nacional, Sr. Escorriola, and staff from POLIUNA and Ministry of Health.

Meeting at GTZ with Ing. Klaus Kresse

Tour of Plastipack (Grupo Polymer) plant; examination of recycling equipment and proto-type products; discussion with Plant Manager.

May 20: Meeting with Ing. Jaun Jose Umana (General Manager) and Ing. M. Teresa Lachner (Project Analyst) of Costa Rica-Canada Foundation; discussion of Recina plastics recycling facility, and potential market opportunities in construction projects in Costa Rica.

Meeting with Lic. Lenin Corrales (Proyecto ECO-OK) and Lic. Roxana Salazar (Fundacion Ambio).

May 23: Tour of Recina recycling facility in San Jose.

May 24: Tour of banana plantation near Guapiles, including examination of recycling operations (plastics) and other operations at EARTH school; discussions with production manager; examination of handling facilities and procedures for agri-chemicals.

May 26: Presentation and seminar discussion at Universidad Nacional, involving 50 to 60 representatives from government, the plastics industry, recycling operations, education, foundations, and the public.

May 27: Meeting with Ing. Victor Ojeda, special advisor to the President, to discuss plastics recycling and solid waste management issues in Costa Rica.

Meeting with Ing. Kresse (GTZ), Ing. Villalobos and other Ministry of Health staff to discuss draft Table of Contents and preliminary findings from research.

Meeting with Ing. Victor Rios of Barriplast to discuss recycling of banana plastics in Columbia and Costa Rica, and market development opportunities.

APPENDIX B:

Recycling (Reprocessing Equipment - Sorema Plastics Recycling System)

● Instalaciones Sorema

● Impianti Sorema

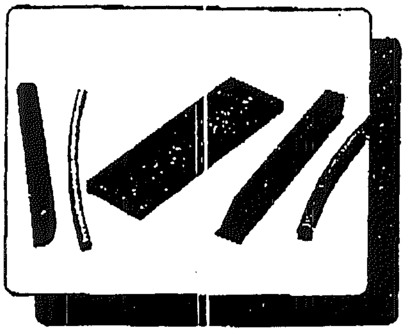
der Kosten die Versorgungsquellen zu erweitern; Einschränkung der Energiekosten: grundlegende wenn nicht gar hauptsächliche Komponente der Erzeugung. Die Sorema hat investiert und investiert auch derzeit bedeutende ökonomische und menschliche Mittel für die Entwicklung immer mehr leistungsfähiger und ausschließlicher Systeme. Unsere mehr als zehnjährige Erfahrung ermöglicht es uns, dem Markt Anlagen zu präsentieren, die einen unvergleichbaren Grad an Zuverlässigkeit besitzen, sowohl vom Standpunkt der Mechanik wegen der Überdimensionierung aller Organe wie auch wegen der Qualität der unter dem Besten, das der Markt bietet, gewählten Bestandteile wie auch wegen des Verfahrens. Unsere Gesellschaft beschränkt sich nicht nur auf die einfache Lieferung der Anlagen, sondern bleibt mit dem Kunden bei allen Phasen des Ausklügelns des layout, der Bauarbeiten bis zur Marktforschung, der Versorgungsquellen und des Verkaufes, der Unterweisung des Personals für die gewöhnliche und außerordentliche Bedienung der Anlage, wobei alle entwickelten technologischen Neuerungen vorgeschlagen werden. Nachfolgend, um die Anlage immer konkurrenzfähig und auf dem letzten Stand zu halten, auch bezüglich der immer neuen Ausnützungssektoren.

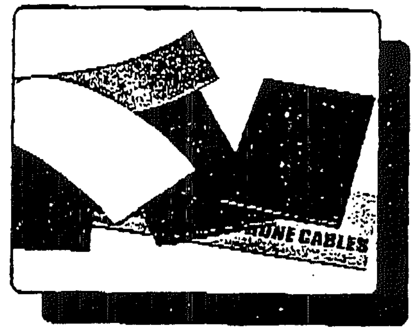
● Instalaciones completas para la recuperación de materiales plásticos provenientes de desechos industriales, agrícolas, y residuos urbanos con capacidad de: 100 - 250 - 500 - 1000 - 2000 Kg./h. en los modelos para desechos limpios, ligeramente, medianamente o altamente contaminados.
Fábrica de regeneración llaves en la mano.
Sistemas de almacenaje y alimentación forzada para film y fibra molida adaptable a cualquier tipo de extrusora de 60 a 200 mm. ∅.
Sistemas de ensilaje, mezcla, transporte, pesada, ensacado por sistemas de coloración, aditivación, y carga de los materiales recuperados.
A petición estudiamos problemas especiales.
Contamos con la más larga experiencia en este sector en el cual obramos exclusivamente para la realización y el desarrollo de nuevas tecnologías en instalaciones extremadamente flexibles y confiables, patentadas en todos los países industriales.
La ganancia en este sector surge de estos componentes principales.
Coste contenido del material adquirido: instalaciones aptas para separar sin dificultad todo tipo de contaminación, tal como papel, madera, arena, vidrio, grasa, metales ferruginosos y no ferruginosos, polvo, ABS, PS, PVC, etc.... que permiten ampliar las fuentes de abastecimiento, disminuiendo el coste; un contenido coste energético: componente básico si no el principal de los costos de producción.
Sorema ha invertido, y sigue todavía invertiendo, notables recursos económicos y humanos en el desarrollo de sistemas siempre más eficaces y exclusivos.
Nuestra experiencia más que decenaria nos permite presentar en el mercado instalaciones que logran un grado de confiabilidad sin igual: tanto desde el punto de vista mecánico, por el supra-tamaño de todos los órganos, por la calidad de los componentes escogidos entre lo mejor del mercado, como por el proceso.
Nuestra Sociedad no se limita al simple abastecimiento de las instalaciones, sino atiende al cliente desde primeras fases del estudio del layout, de las obras civiles a las investigaciones de mercado, de las fuentes de abastecimiento y de venta, a la enseñanza de los empleados para la gestión ordinaria y extraordinaria de la instalación, proponiendoles cada innovación tecnológica desarrollada. Y también sucesivamente, para mantener la instalación siempre más al día y de la máxima competencia, relativamente a los siempre nuevos sectores de explotación.

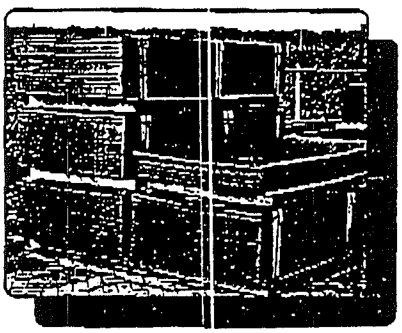
● Linee complete di recupero materie plastiche provenienti da scarti industriali, agricoli e rifiuti urbani con capacità di: 100 - 250 - 500 - 1000 - 2000 Kg./h. nelle versioni per scarti puliti, leggermente, mediamente o altamente contaminati.
Stabilimenti chiavi in mano di rigenerazione.
Sistemi di stoccaggio e alimentazione forzata per film e fibra macinata adattabili a qualsiasi tipo di estrusore da 60 a 200 mm. ∅.
Sistemi di insilaggio, miscelazione, trasporto, pesatura, insaccaggio, colorazione, additivazione e carica dei materiali rigenerati.
Su richiesta si studiano problemi particolari.
Depositari della più lunga esperienza in questo settore nel quale opera esclusivamente per la realizzazione e lo sviluppo di nuove tecnologie in impianti estremamente flessibili ed affidabili, brevettati in tutti i paesi industriali.
Il profitto in questo settore nasce da queste componenti principali. Contenimento del costo del materiale acquistato. impianti capaci di separare senza difficoltà ogni tipo di contaminazione come carta, legno, sabbia, vetro, grasso, metalli ferrosi e non ferrosi, polvere, ABS, PS, PVC, ecc. che permettono di ampliare le fonti di approvvigionamento riducendone il costo; contenimento del costo energetico, componente fondamentale se non la principale dei costi di produzione.
La Sorema ha investito ed investe tuttora, notevoli risorse economiche ed umane nello sviluppo di sistemi sempre più efficienti ed esclusivi.
La ns. ultradecennale esperienza ci permette di presentare sul mercato impianti che hanno un grado di affidabilità ineguagliabile: sia dal punto di vista meccanico, per il sovradimensionamento di tutti gli organi, per la qualità della componentistica scelta fra quanto di meglio il mercato offre, sia per il processo.
La ns. società non si limita alla semplice fornitura degli impianti, ma segue il cliente fin dalle prime fasi dello studio del Layout, delle opere civili alle ricerche di mercato, delle fonti di approvvigionamento e di vendita, all'istruzione del personale per la gestione ordinaria e straordinaria dell'impianto, proponendogli ogni innovazione tecnologica sviluppata. In seguito, per mantenere sempre più aggiornato e competitivo l'impianto in relazione anche ai sempre nuovi settori di sfruttamento.

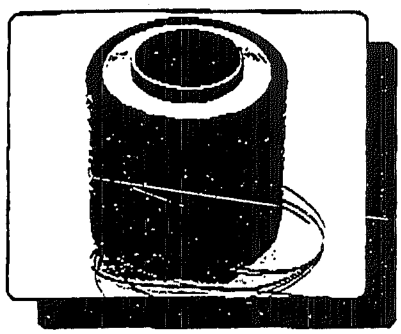
sorema

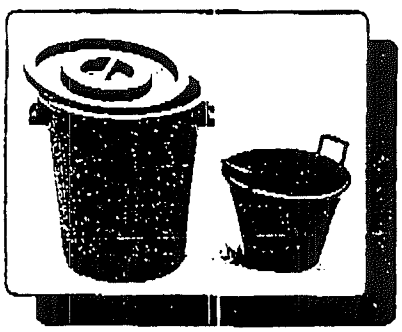
PLASTICS RECYCLING SYSTEMS



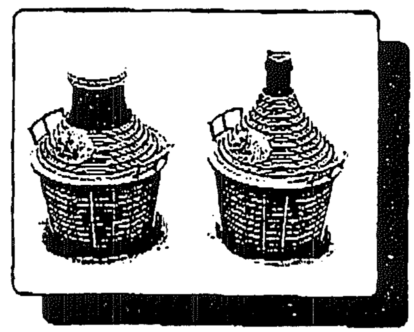


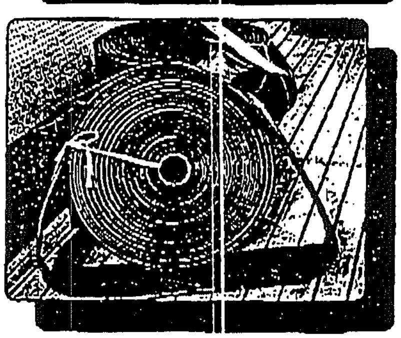


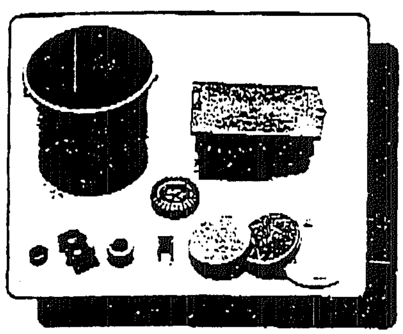


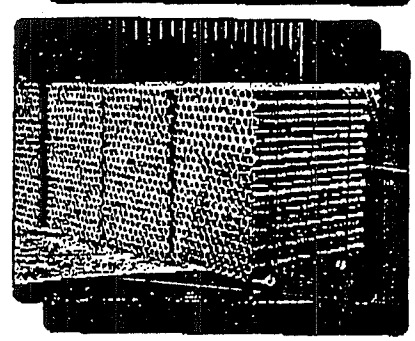


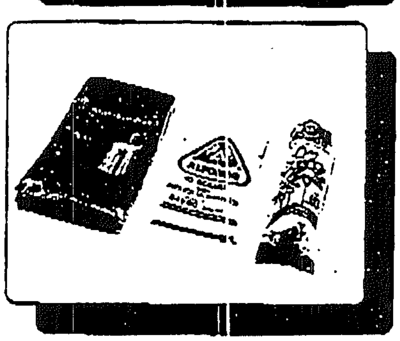
- Obtainable products
- Produits obtenibles
  Erreichbare Produkte
- Productos obtenibles
- Prodotti ottenibili

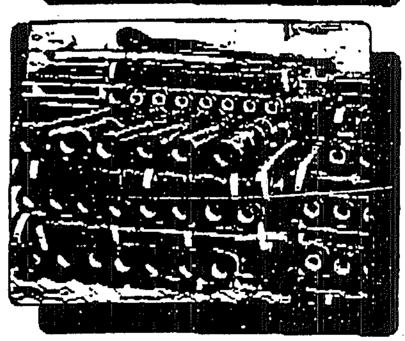


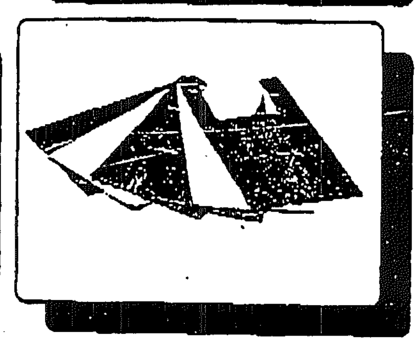












Advanced Recycling Technology

Overview

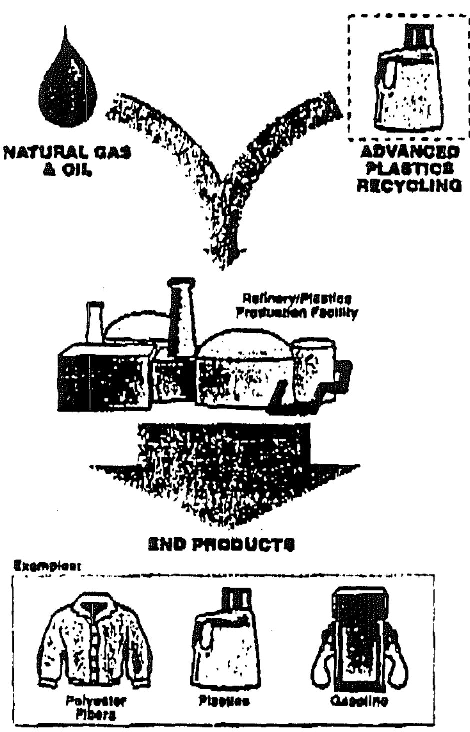
A new approach to recycling used plastics is being taken in the United States and abroad that may offer a means of significantly increasing the overall quantity of plastics that can be recycled. Called "advanced recycling technologies," this new approach may provide advantages that overcome familiar problems associated with some conventional plastic recycling efforts: costly sorting of the different types of plastics; concerns about quality of end products; and finding reliable markets for products made from recycled plastics.

Advanced recycling technologies are processes that yield a variety of versatile and marketable end-products that are the building blocks from which new plastics and a variety of other products can be manufactured. This is achieved by converting or recycling plastics back into the raw materials from which they were made. These processes can recycle more types of plastic, and do not require them to be washed or sorted by color or type.

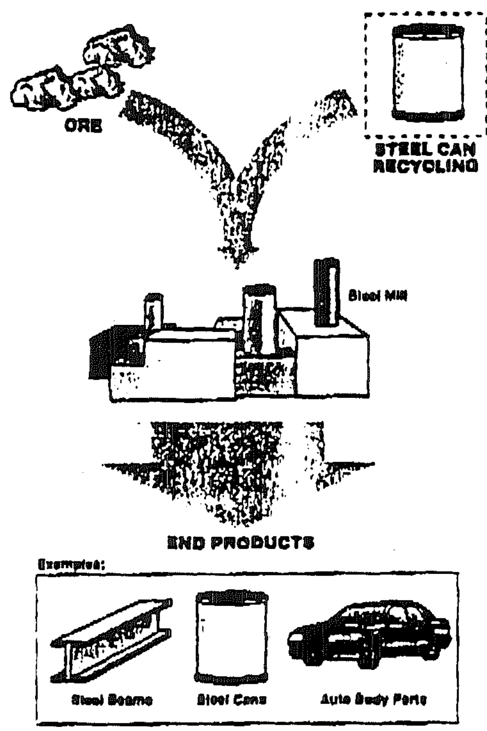
Advanced recycling also eliminates the grinding, shredding and extruding processes used in conventional plastics recycling.

Like all forms of recycling, advanced recycling technologies conserve natural resources, divert greater amounts of plastic from landfills and produce useful, marketable products.

PLASTICS



STEEL



Advanced plastics recycling is similar in many ways to the recycling technologies used for other materials, such as steel. Used steel cans are heated and converted back to raw steel that is then used to make products such as auto bodies, steel construction beams and new steel cans. In comparison, advanced plastics recycling systems convert post-consumer plastics back to raw materials. The resulting raw materials are then used to produce a range of products, including new plastics and synthetic fibers.

Advanced Recycling Technology

Conrad Industries Recycling System

The American Plastics Council (APC) is working with Conrad Industries, Inc., of Centralia, Washington to conduct a demonstration program involving an advanced recycling process that recycles plastics back into the raw materials from which they were made.

This project is part of the APC's overall program to increase the recycling rate for plastics and develop or expand new technologies.

Conrad's recycling system applies heat to post-consumer plastics in the absence of oxygen. Once heated, the plastics are converted back into liquid petroleum products. These products are then shipped to refineries and plastics production facilities for use in producing new products like synthetic fibers and new plastics.

In addition to liquid petroleum products, this recycling process produces small amounts of solid carbon (5-10%) and light gases (10-15%). The carbon is sold for use in the production of activated carbon, pigments, rubber goods, and applications in oil remediation and agriculture. The gas is recycled on site and used as a source of energy for the recycling unit.

The Conrad recycling process is an exciting development in plastics recycling because it conserves natural resources, diverts materials from landfills and produces marketable, useful products.

The Conrad demonstration recycling program will follow two tracks:

- A small-scale demonstration system will examine how various types of plastics perform under different conditions using this process. The data acquired from this unit will help to refine the process conditions for a commercial-scale demonstration and to identify potential design improvements.

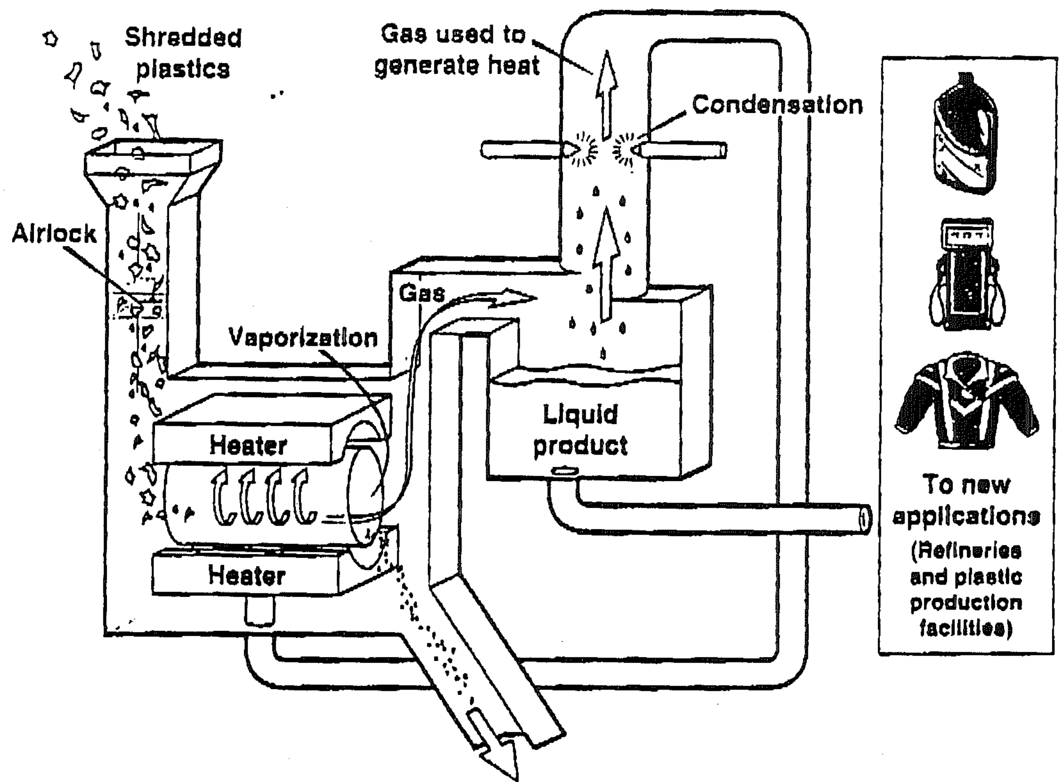
- A commercial-scale recycling system is expected to begin recycling post-consumer plastics by the end of 1993. Initially, post-consumer, pigmented, high-density polyethylene (HDPE) bottles will be acquired in the Northwest region for use in the commercial-scale recycling unit. Other post-consumer plastics may be added as the program progresses. Plastic bottles currently recycled in other programs will not be targeted.

The objective of the partnership between Conrad and the APC is to learn more about a new technology and to recycle more and different plastics than are currently being recycled in the Northwest. Both advanced and mechanical plastics recycling are viewed by the plastics industry as important elements of an integrated solid waste management system that will contribute to resource conservation and reduction of landfill-disposed waste.

CONRAD INDUSTRIES, INC.

Advanced Recycling Technology

How it works



Conrad Industries, Inc., of Centralia, Washington is working with the American Plastics Council (APC) to demonstrate the use of an advanced recycling process that recycles plastics back into the raw materials from which they were made. This process is an exciting development in plastics recycling because it conserves natural resources, diverts more materials from landfills and produces marketable, useful products. In fact, this recycling system is quite similar to the processes used to recycle other materials such as glass, aluminum and steel.

The recycling system used in this demonstration applies heat to plastics in the absence of oxygen to produce liquid petroleum, carbon and gas products. The process begins by feeding shredded plastics into the system through an air lock to prevent air from entering the system. The plastics are then moved, via rotating paddles, through a heated tube that reaches temperatures of around 1000 degrees Fahrenheit.

Using these high temperatures in the absence of oxygen transforms the plastics into gas and small amounts of carbon, which then move out the other end of the tube. At this point, carbon exits the system and is collected for sale. The gases then move to a condensation step, where most are condensed into a liquid product. Any gases that are not condensed are used within the system to generate heat for transforming plastics entering the tube.

The liquid product is shipped to refineries and plastics production facilities for use in producing new products like synthetic fibers, new plastics and other petroleum-based products. It represents about 70-80 percent of the final output of this system. The carbon (5-10 percent) is sold for use in the production of activated carbon, pigments, rubber goods, and applications in oil remediation, and agriculture.

The objective of this project is to increase the quantity and variety of plastics being recycled in the Pacific Northwest and, eventually, in other areas of the United States. Both advanced and traditional plastics recycling are seen by the plastics industry as important elements of an integrated solid waste management system that will contribute to reduction of landfill-disposed waste and the conservation of natural resources.

Advanced Recycling Technology

About Conrad Industries and the American Plastics Council

What is Conrad Industries, Incorporated?

Conrad Industries was originally formed in 1955 in western Washington state. The company operates systems and equipment for materials handling, transportation and recycling. Most of the company's projects are local or regional in nature. The president of Conrad Industries is Mr. Bill Conrad.

In the early 1980's, Conrad Industries and Kleenair Products Company of Clackamas, Oregon, designed and subsequently operated a commercial system to recycle X-ray film and recover its silver content. In 1986, the same technology was used to design and operate a larger-scale unit for recycling used tires. More recently, Conrad has been working with the American Plastics Council to demonstrate how a similar process can be used to recycle post-consumer plastics.

CONRAD INDUSTRIES, INC.

What is the American Plastics Council?

The American Plastics Council, a joint initiative with The Society of the Plastics Industry, Inc., comprises 25 of the nation's leading plastic resin producers. Among the goals of the American Plastics Council are:

• to further improve the environmental performance of plastics through recycling, conservation and resource recovery programs; and

• to articulate the important roles plastics play in today's world.

To meet these goals, the American Plastics Council is organized into four task forces that address product stewardship, advocacy, outreach and mobilization of the industry itself.

The APC's members are: Amoco Chemical Company, ARCO Chemical Company, BASF Corporation, Chevron Chemical Company, The Dow Chemical Company, DuPont, Eastman Chemical Company, Exxon Chemical Company, FINA Oil and Chemical Company, General Electric Plastics, HIMONT Incorporated, Hoechst Celanese Corporation, Huntsman Chemical Corporation, ICI Polyurethanes, Lyondell Petrochemical, Miles Inc., Mobil Chemical Company, Monsanto Chemical Company, Novacor Chemicals, Inc., Occidental Chemical Corporation, Phillips Petroleum, Quantum Chemical Corporation, Shell Chemical Company, Solvay Polymers, Inc., and Union Carbide Corporation.

Why are Conrad Industries and the APC working together?

The plastics industry has been exploring advanced recycling technologies as a means of expanding the plastics recycling infrastructure for about four years. With the APC's expertise in plastics recycling and interest in increasing plastics recycling rates, Conrad's patented recycling technology may offer a means of increasing recycling rates in the Pacific Northwest and learning more about advanced recycling technologies.

The recycling process at Conrad may also offer a particularly practical way to recycle plastics because it can be applied to all plastics, and most importantly, to commingled, post-consumer plastics. In addition, the environmentally benign recycling process used at Conrad Industries is a relatively low-capital-cost technology that may make it economically attractive to municipalities, recyclers and waste management facility operators.

sorema

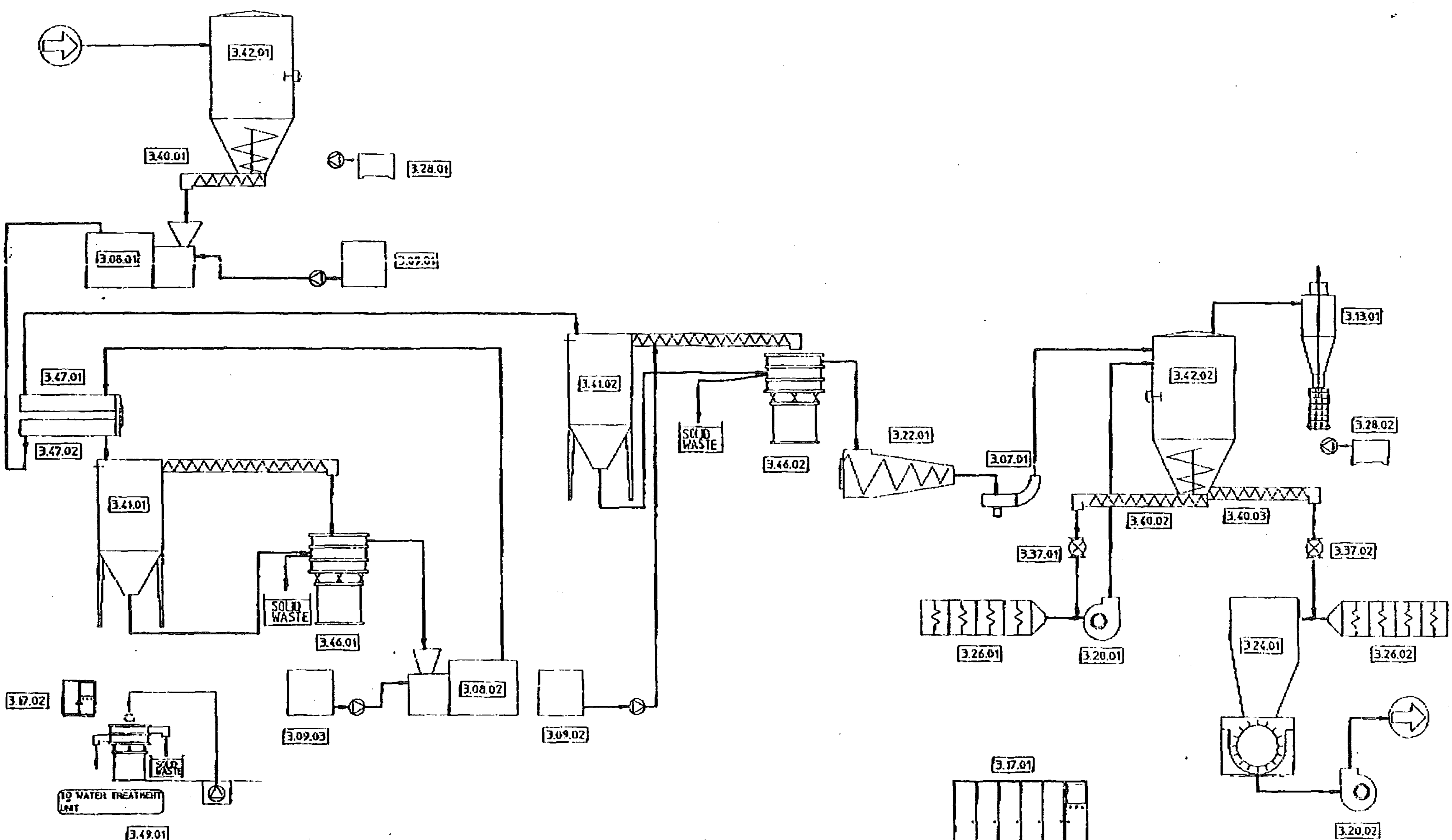
RECYCLING PLANT TYPE FR 1000/160 F+G-PW

Technical data

– workable materials	:	LDPE – HDPE – PP
– shape of the materials to recover	:	films - crates - solids
– output of the washing line	:	750 - 1200 Kg./h.
– output of the extruding line	:	750 - 1100 Kg./h.
– power applied to the pretreatment plant	:	188,55 Kw.
– power applied to the washing line	:	311 Kw.
– power applied to the extrusion line	:	530,73 Kw.
– power applied to the optionals	:	98,21 Kw.
– total power applied	:	1.128,49 Kw.
(absorbed +/- 60% abt.)		
– water consumption	:	6000/16000 Lt./h.
– water pressure	:	3 Ate
– air consumption	:	2 Nm3/h.
– pretreatment surface	:	126,5 sq.m. - 11x11,5x6,2h.
– washing surface	:	120 sq.m.- 20x6x6,5h
– extrusion surface	:	123,5 sq.m. - 19x6,5x7,2h.
– max. distance between the groups	:	25 m.
– labour required	:	3 persons per shift

N.B. The output and the water consumption can change according to the thickness and the viscosity of the processed material.

SOREMA reserves the right to change the installation with notice at the same output and functionality level.



ITEM	DESCRIPTION	ITEM	DESCRIPTION
		3.49.00	WATER FILTERING SYSTEM
3.24.00	GRINDER	3.47.00	WASHING TUBE
3.22.00	FILTER PRESS	3.46.00	VIBRATING SCREEN
3.20.00	FAN	3.42.00	SILO
3.17.00	ELECTRIC PANEL	3.41.00	SEPARATING TANK
3.13.00	CYCLON	3.40.00	SCREW CONVEYOR
3.09.00	CONVEYING TANK	3.37.00	ROTARY VALVE
3.08.00	CONVEYING GROUP	3.28.00	HYDRAULIC UNIT
3.07.00	CENTRIFUGE	3.26.00	HEAT EXCHANGER

COLLOCAZIONE

FD - 01 - 05

FLOW DIAGRAM
WASHING PLANT

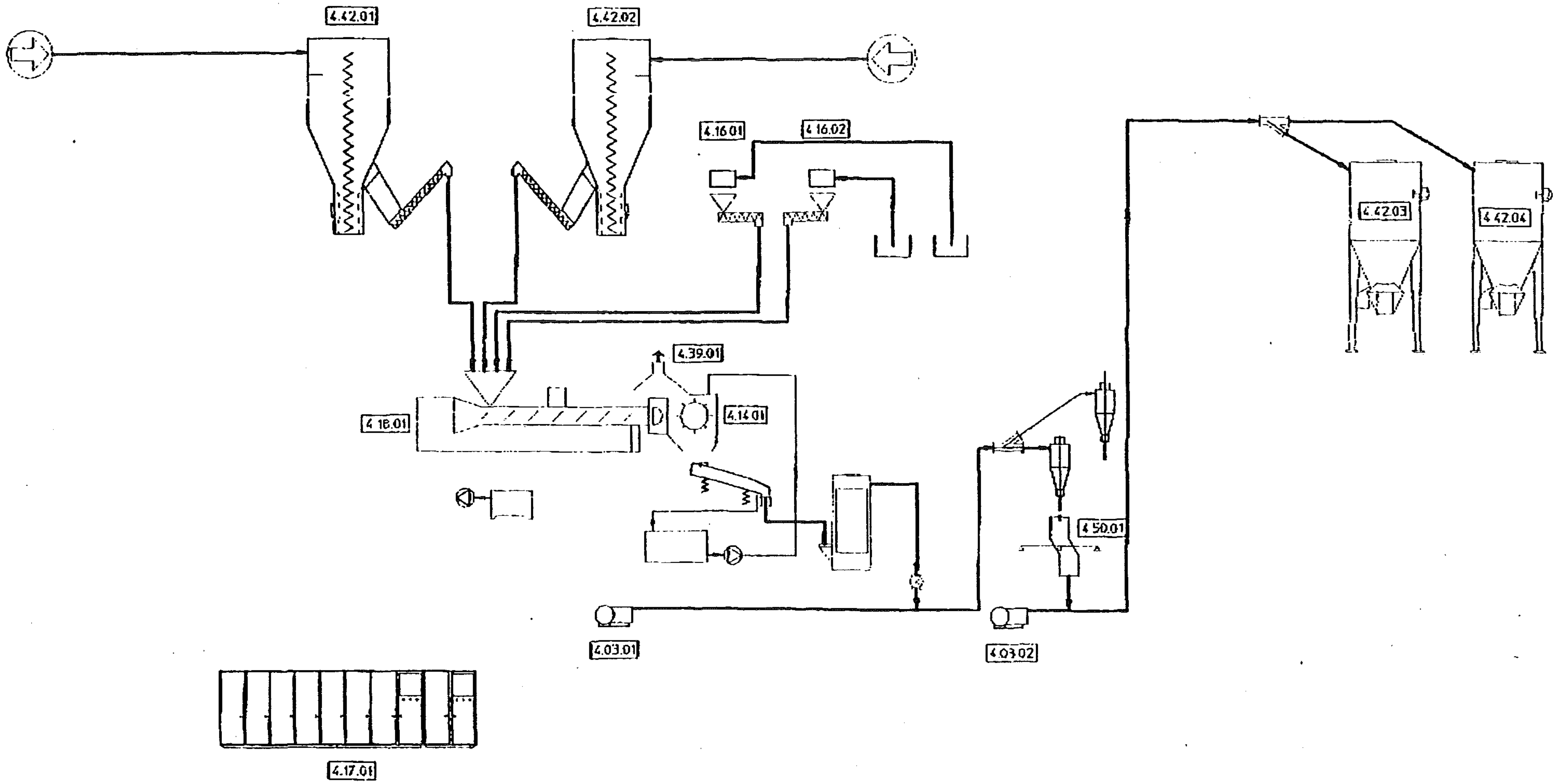
RATTI

03-06-1992

001562_FD_01_B

SI 01 69

Sorema



COLLOCAZIONE

FD - 01 - 34

00	ELECTRIC PANEL		
00	DOSING UNIT	4.50.00	WEIGHING SYSTEM
00	DIE FACE CUTTER	4.42.00	SILO
00	CYCLON	4.39.00	SCREEN CHANGER
.00	AIR COMPRESSOR	4.18.00	EXTRUDER
	DESCRIPTION	ITEM	DESCRIPTION

FLOW DIAGRAM
EXTRUSION PLANT

RATTI

23-06-1992

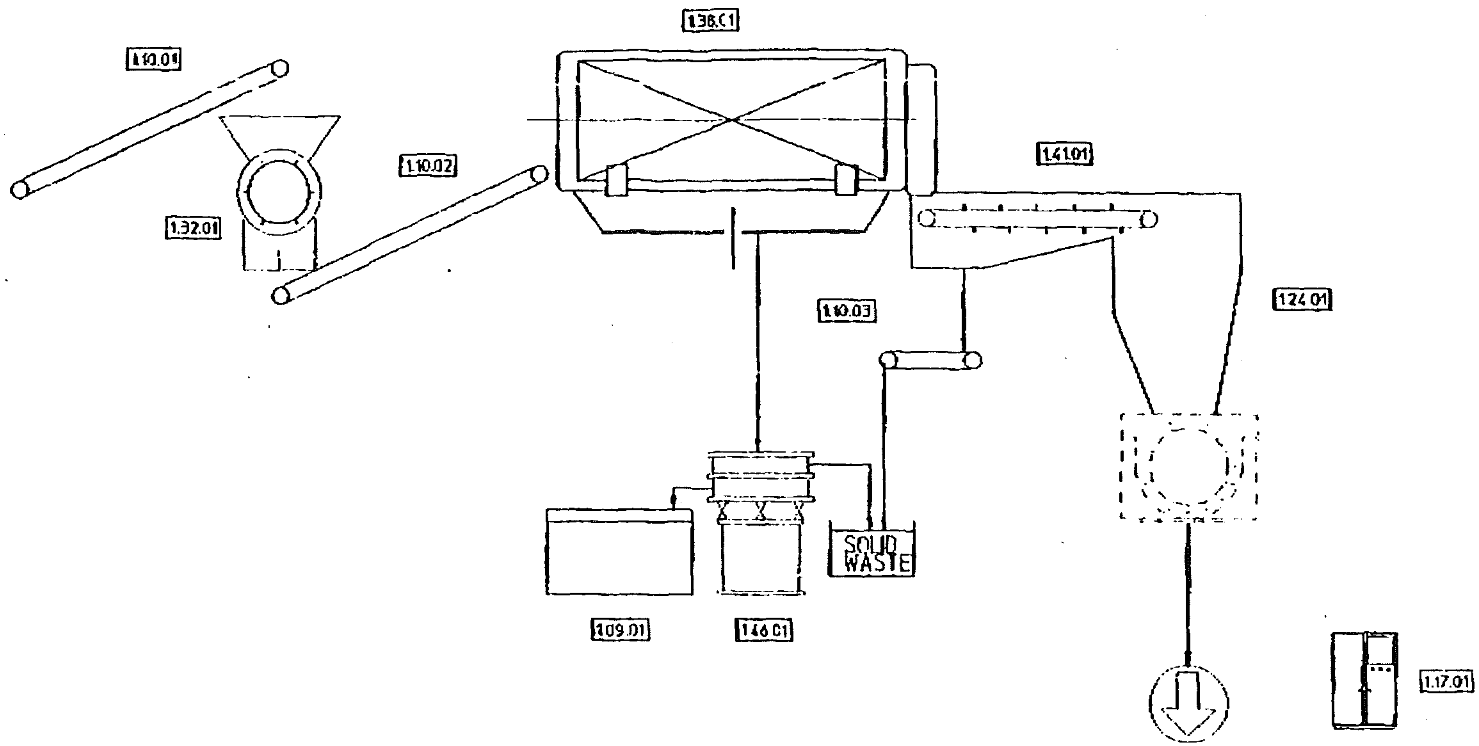
Soremo

001764_FD_03_A

SI 01 104

APPENDIX C:

Pyrolysis System - Conrad Industries



ITEM	DESCRIPTION	ITEM	DESCRIPTION
24.00	GRINDER	1.46.00	VIBRATING SCREEN
17.00	ELECTRIC PANEL	1.41.00	SEPARATING TANK
10.00	CONVEYOR BELT	1.38.00	ROTATING SCREEN
09.00	COLLECTING TANK	1.32.00	PRE-BRAKER

FLOW DIAGRAM PRETREATMENT
AND GRINDING PLANT

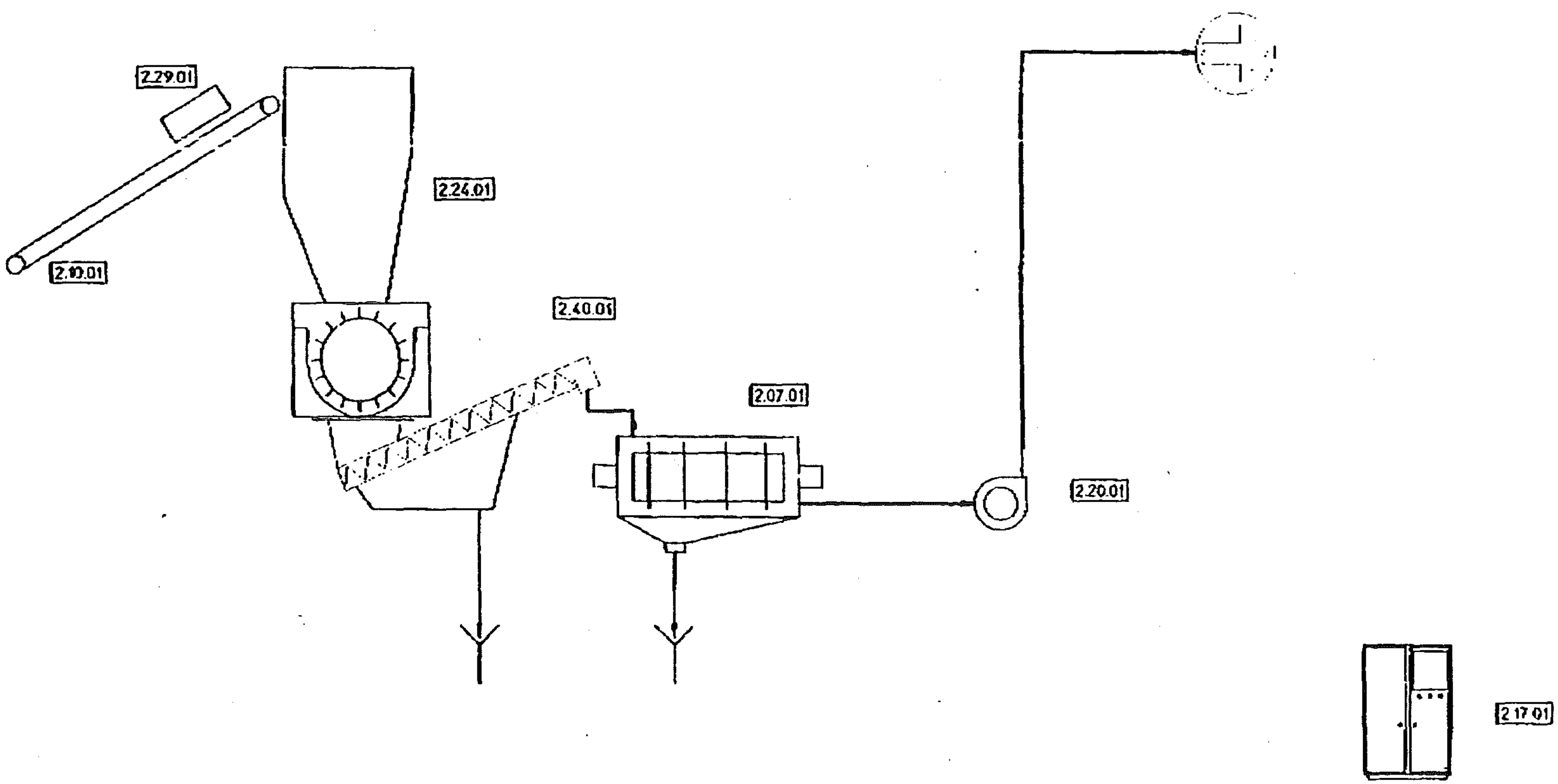
RATTI

20-05-1993

Soferma

002760_FD_01_B

FD 01 89



COLLOCAZIONE

FD - 01 - 04

.00	GRINDER		
.00	FAN		
.00	ELECTRIC PANEL		
.00	CONVEYOR BELT	2.29.00	METAL DETECTOR
.00	CENTRIFUGE	2.40.00	SCREW CONVEYOR
	DESCRIPTION	ITEM	DESCRIPTION

FLOW DIAGRAM
GRINDING PLANT

RATTI

23-06-1992

Ssoiema

001560_FD_02_A

SI 01 67

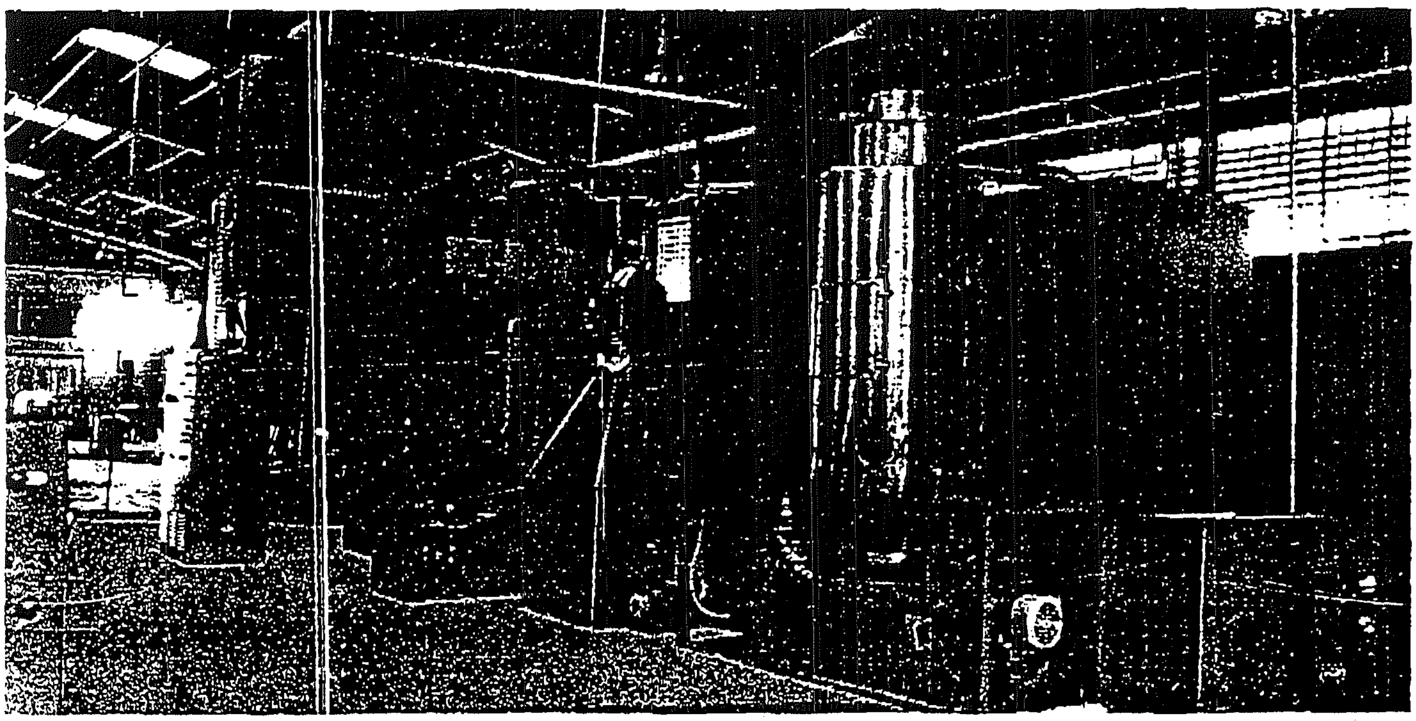
● **Separation and washing plants, models compact L & M**
● **Installations de separation et lavage type compact L & M**
Abscheide - und waschanlagen typ compact L & M
● **Instalaciones de separacion y lavado tipo compoct L y M**
● **Impianti di separazione e lavaggio tipo compact L & M**

● Available in the 100/250/500/1000 Kg./hr. versions for recycling industrial and agricultural wastes which have low or medium percentage contamination levels. They can be combined with the same size RF plants to complete a recycling line.
Process phases:
The material coming from the grinding phase, is dosed, through a storage silo, for washing. This last, during successive cycles, washes, separates, rinses and dries once or several times, depending on the percentage and type of contamination as well as on material thickness. These plants can be supplied with gas, electric or steam drying.

● Ces installations réalisées dans les version 100/250/500/1000 Kg./h. pour la récupération de déchets industriels et agricoles avec basse et moyenne contaminations peuvent doubler les installations RF de la même grandeur pour compléter la ligne de régénération.
Phases de travail:
Le matériel provenant de la phase de broyage, est dosé au lavage à travers un silo de stockage qui, dans des cycles successifs, lave, sépare, rince et sèche une ou plusieurs fois suivant le pourcentage et le type de contamination ainsi que l'épaisseur du matériel.
Ces installations peuvent être livrées avec systèmes de séchage au gaz, à l'électricité ou à la vapeur.

Realisiert in den Versionen 100/250/500/1000 kg/h für die Rückgewinnung von Industrie- und Landwirtschaft-Abfällen mit niedriger oder mittlerer Verschmutzung, können sie mit den Anlagen RF derselben Größe für die Vervollkommnung der Regenerierlinie verbunden werden.. Arbeitsphasen: Das von der Mahlphase kommende Material wird durch einen Einlagersilo für die Wäsche dosiert, wonach in nachfolgenden Zyklen gewaschen, abgeschieden, gespült und getrocknet wird, einmal oder öfter je nach der Art der Verschmutzung sowie der Dicke des Materials.
Diese Anlagen können mit elektrischer Trocknung, Gas - oder Dampftrocknung geliefert werden.

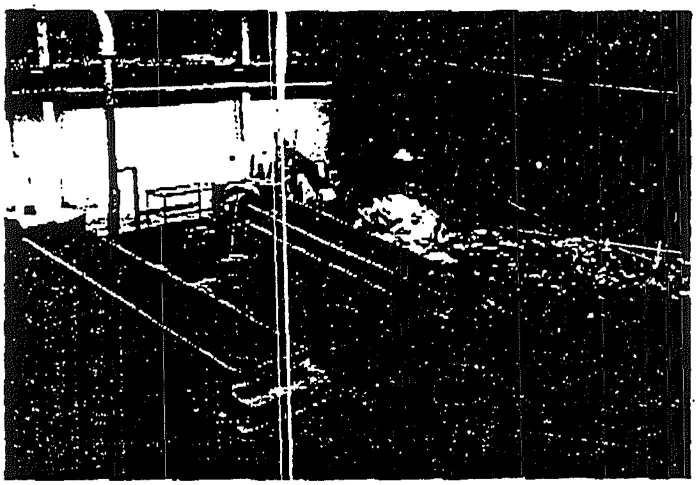
● Realizadas en los modelos 100/250/500/1000 Kg/h. para la recuperación de desechos industriales y agrícolas de baja y media contaminación pueden ser acopladas con las instalaciones RF de mismo tamaño para el completamiento de la línea de regeneración.
Fase de elaboración:
El material proveniente de la fase de la moledura, por través de un silo de almacenaje, viene dosificado al lavado que, en ciclos sucesivos, lava, separa, enjuaga y seca una o más veces según el porcentaje y el tipo de contaminación y además del espesor del material.
Estas instalaciones pueden ser abastecidas con secado de gas; eléctrico o de vapor.



● Realizzati nelle versioni 100/250/500/1000 Kg./h. per il recupero di scarti industriali ed agricoli con basse e medie contaminazioni sono abbinabili agli impianti RF della stessa grandezza per il completamento della linea di rigenerazione.
Fasi di lavorazione:
Il materiale proveniente dalla fase di macinazione, tramite un silo di stoccaggio viene dosato al lavaggio che, in cicli successivi, lava, separa, risciacqua ed essica una o più volte a seconda della percentuale e del tipo di contaminazione nonché dello spessore del materiale.
Questi impianti possono essere forniti con essicazione a gas, elettrica o a vapore.

● Plants type RF
● Installations type RF
Anlagen typ RF
● Instalaciones tipo RF
● Impianti tipo RF

● Suitable for recycling LDPE - HDPE - PP - PS in clean film, sacks, boxes, bottles, raffia, monofilaments, lumps etc.
Available in the 100/250/500/1000/2000 Kg./hr. versions.
Process phases:
The operator feeds the granulator (as an optional, it can be supplied with a metal-detector), reducing the material to a size suitable for the successive phases. A fan conveys



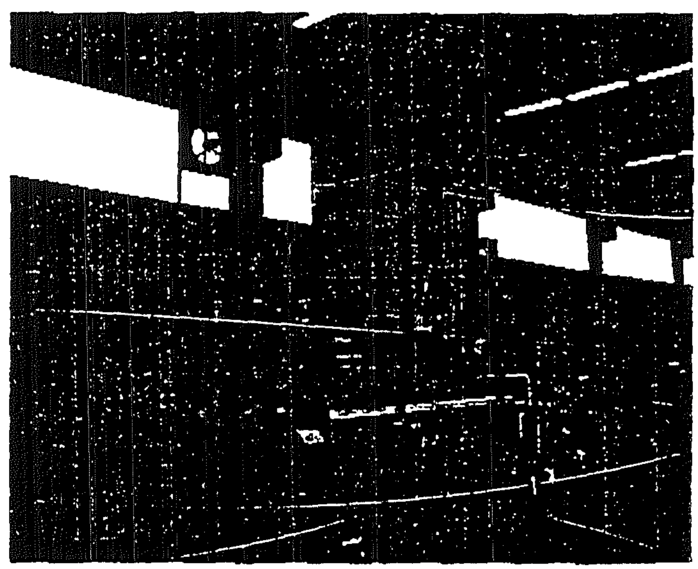
the material to a patented storage and mixing silo which automatically and constantly, feeds the forced feeding hopper of the extruder with degassing and, in case of contaminated material, the washing silo.
The extrusion line may be supplied with a pelletizer, cube-dicer or face cutting machine, depending on needs.

● Elles s'adaptent à la récupération de LDPE - HDPE - PP - PS en film, sacs, caissettes, bouteilles, rafia, monofilaments, masselottes, etc. à l'état propre.
Elles sont réalisables dans les versions de 100/250/500/1000/2000 Kgs./h.
Phases de travail: l'opérateur alimente le broyeur (sur demande il peut être livré avec metal-détector), réduisant le matériel en une mesure optimale en vie des phases successives, un ventilateur transporte le matériel à un silo de stockage et mélange brévété lequel alimente constamment et automatiquement la trémie forcée de l'extrudeuse avec dégazage et, dans le cas de matériel contaminé, le silo du lavage. La ligne d'extrusion peut être livrée, suivant les exigences, avec granulateur á joncs, granulateur à bande ou coupe en tête.

Geeignet für die Rückgewinnung von LDPE - HDPE - PP - PS aus reinen Film, Säcken, Kisten, Flaschen, Bast, einfachem Glühdraht, verlorene Köpfe usw.
Sie werden in den Versionen von 100/250/500/1000/2000 Kg./h. realisiert.
Bearbeitungsphasen: Der Bediener der Anlage speist die Granuliermühle (auf Wunsch kann sie mit einem Metall-Detektor geliefert werden), wodurch das Material auf ein optimales Maß für die nachfolgenden Phasen reduziert wird, ein Ventilator fördert das Material zu einem patentierten Einlager- und Misch-Silo, der stetig und selbsttätig den angetrieberen Trichter der Extruder mit Entgasung speist, im Falle von verschmutztem Material der Waschsilo.
Die Extrusionlinie kann laut der Notwendigkeit mit einer Strandgranulator, Bandgranulator oder Unterwasserschneidkopf geliefert, werden.

● Aptas para la recuperación de LDPE - HDPE - PP - PS en film, sacos, cajas, botellas, rafia, monofilamentos, mazarotas, etc... limpios.
Están realizados en los modelos de 100/250/500/1000/2000 kg/h.
Fases de elaboración:
El operador alimenta el molino de granulación (a petición puede ser abastecido con metal-detector) reduciendo el material a una medida óptima para las fases sucesivas, un ventilador transporta el material a un silo de almacenaje y mezcla patentado que alimenta constante y automaticamente la tolva forzada de la trefiladora con desgasificación y, en caso de material contaminado, el silo del lavado.
La instalación de extrusión puede ser abastecida ségun las exigencias con cortadora de hilos, cubeteadora o corte en cabeza.

● Adatti al recupero di LDPE - HDPE - PP - PS in film, sacchi, cassette, bottiglie, rafia, monofilamenti, materozze ecc., puliti.
Sono realizzati nelle versioni da 100/250/500/1000/2000 Kg./h.
Fasi di lavorazione: L'operatore alimenta il mulino granulatore (a richiesta può essere fornito con metal detector), riducendo il materiale ad una misura ottimale per le fasi

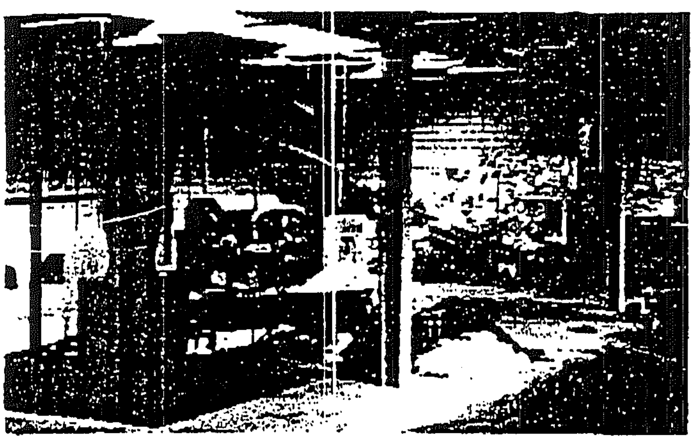


successive, una ventola trasporta il materiale ad un silo di stoccaggio e miscelazione brevettato che alimenta costantemente et automaticamente la tramoggia forzata della trafila con degasaggio e, nel caso di materiale contaminato, il silo del lavaggio. La linea di estrusione può essere fornita a seconda delle esigenze con taglierina, cubettatrice o taglio in testa.

- **Prewashing plant type 1000/W**
- **Installation de prelevage type 1000/W**
  Vorwaschanlage typ 1000/W
- **Prelevado tipo 1000/W**
- **Impianto di prelavaggio tipo 1000/W**

● Developped for very high and abrasive contamined plastics makes now possible and economical the recycling of: greenhouse sheetings, fertilizer bags,hay storage film, urban waste after selection,greenhouse sheetings, mulshing matenal, peat bags and bags with incompatible granules. The big advantages of this plant are: separation of dangerous contaminants such as sand, stones, glass and metal, automatic feeding of bales through guillottine, great reduction of water consumption and wear of working component, increase of SOREMA washing plant production and quality. After the prewashing the material is conveyed to the washing plant granulator.
Available in the versions 500 and 1000: Kg./h.

● Dévéloppée pour matériaux très contaminés et abrasifs rend maintenant possible et économique le recyclage de: film agricoles pour serres, sachets de fertilisants, film d'ensilage, déchets provenants d'ordures ménagères préselectionnés, miniserres, film de paillage, sacs de tourbe ed sacs avec des granules incompatibles. Les grands avantages de cette installation sont: séparation des contaminants dangereux comme sable, pierres, verre et métaux, alimentation automatique des balles avec guillottine, grosse réduction de consommation d'eau et des pièces sujets à usure, augmentation de la production et qualité de l'installation de lavage SOREMA. Après le procédé de prélavage le matériel est convoyé au broyeur de l'installation de lavage.
Réalisées dans les versions 500 et 1000 Kg./h.



Macht jetzt die Verarbeitung von folgenden mit Abrasivmaterialien stark verschmutzten Folien möglich: Landwirtschaftsfolien, Düngemittelsäcke, Silo-Abdeckfolien, aussortierte Stadtabfälle, kieine Treibhäuser, Mulshfolien, Torfsäcke und Granulatsäcke mit Fremdmaterialien. Die Großen Vorteile dieser Anlage sind: Trennung von störenden' verunreinigten Materialien wie Sand, Steine, Glas und Metalle, automatische Zuführung von Wasser und leicht verschleißbarer Komponenten, erhebliche Produktion und Qualitätserhöung der Waschanlage SOREMA. Nach dem Vorwaschverfahren, wird das Material and die Schneidmühle der Waschanlage befördert.
Realisiert in den Version 500 und 1000 Kg./pro Stunde.

● Proyectado para materiales muy contaminantes y abrasivos se convierte en posible y economico el reciclaje de: toldos agricolas de invernaderos, sacos de fertilizantes, film para almacenaje del heno, residuos urbanos preseleccionados mini invernaderos, material de desbrozo, sacos de turba y sacos con granulos incompatibiles. Las grandes ventajas de esta instalacion

son: separacion de contaminantes peligrosos como arena, piedra, vidrio y metales, alimentacion automatica de balas por medio de una guillotina, importante reduccion del consumo de agua y de los componentes sujetos a desgaste aumento de la produccion y calidad de las maquinas de lavar SOREMA. Despues del proceso de prelavado el material es conducido al granulador de la maquina de lavar.
Disponible en las versiones de 500 y 1000 Kg./h.

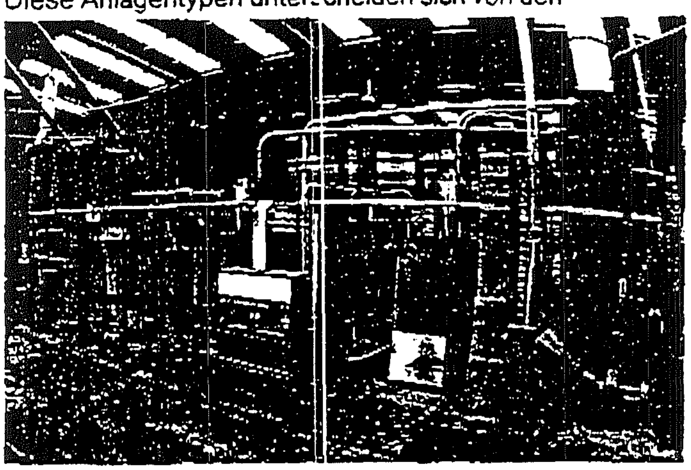
● Sviluppato per materiali molto contaminanti ed abrasivi rende ora possibile ed economico il riciclaggio di: teloni agricoli da serra, sacchi di fertilizzanti, teloni per stoccaggio fieno, rifiuti urbani preselezionati, miniserre, materiale da pacciamatura, sacchi di torba e sacchi con granuli incompatibili.
I grandi vantaggi di questo impianto sono: separazione di contaminanti pericolosi come sabbia, sassi, vetro e metalli, alimentazione automatica di balle attraverso la ghigliottina, notevole riduzione di consumo d'acqua e dei componenti soggetti ad usura, aumento della produzione e qualità dell'impianto di lavaggio SOREMA. Dopo il processo di prelavaggio il materiale viene convogliato al granulatore dell'impianto di lavaggio.
Ottenibile nelle versioni 500 e 1000 Kg./h.

● Separation and washing plants, models RWP and FR
● Installations de separation et lavage type RWP et FR
Abscheide - und wachanlagen typ RWP und FR
● Instalaciones de separacion y lavado tipo RWP y FR
● Impianti di separazione e lavaggio tipo RWP e FR

● Available in the 500 and 1000 Kg/hr. versions, they are suitable for recycling industrial, agricultural and urban wastes which have high contamination percentages. They can be combined with the same size RF plants.
These plants differ from the COMPACTs in the higher number of washing, separation and rinsing cycles and in the higher intensity and accuracy in separating the contaminants.
In these plants too drying may be either with gas, electricity or steam.
Output and water consumption depend on the thicknesses and contamination levels of the materials handled.

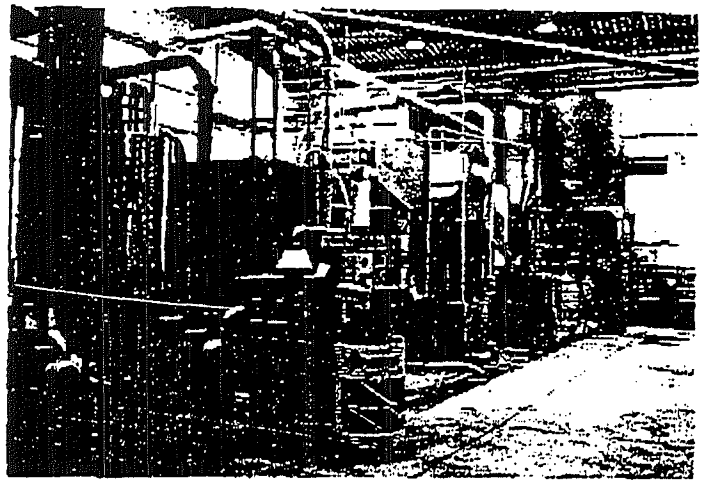
● Réalisées dans les versions 500 et 1000 Kg./h. qui sont convenables pour la récupération des déchets industriels, agricoles et ordures ménagères avec hauts pourcentages de contaminations, pouvant s'adapter aux installations RF de la même grandeur.
Ces types d'installation diffèrent de ceux COMPACT par le nombre plus grand de cycles de lavage, séparation et rinçage et dans la plus haute intensité et précision de séparation des contaminants.
Dans ces installations le séchage peut, sur demande, être au gaz, à l'électricité ou à la vapeur.
La production et la consommation d'eau dépendent des épaisseurs et des contaminations du matériel soumis au procédé.

In der Version 500 und 1000 kg/h realisiert, sind sie geeignet für die Rückgewinnung von Industrie- und Landwirtschaft- Abfall und vom Stadtmüll mit hohem Verschmutzungsprozentsatz und können mit den Anlagen RF der gleichen Größe gepaart werden.
Diese Anlagentypen unterscheiden sich von den



COMPACT durch die größere Anzahl an Wasch-, Abscheide und Spülzyklen und durch die höhere Kraft und Genauigkeit der Abscheidung der Verschmutzmittel.
Auch bei diesen Anlagen kann das Austrocknen auf Wunsch elektrisch oder durch Gas oder durch Dampf erfolgen.
Die Herstellung und der Wasserverbrauch hängen von der Dicke und von der Verschmutzung der behandelten Materialien ab.

● Realizadas en los modelos 500 y 1000 Kg/h. son aptas para la recuperación de desechos industriales, agricolas, y residuos urbanos con altos porcentajes de contaminación, pueden ser acopladas con las instalaciones RF del mismo tamaño.



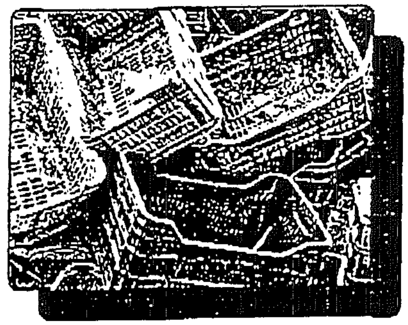
Estos tipos de instalaciones se diferencian de los COMPACT por el mayor numero de ciclos de lavado, separación y enjuagadura y en la más alta intensidad y precisión de separación de los elementos de contaminación.
También en estas instalaciones los secados pueden ser, a petición, de gas, eléctrico o de vapor.
La producción y el consumo del agua dipenden de los espesores y de las contaminaciones de los materiales elaborados.

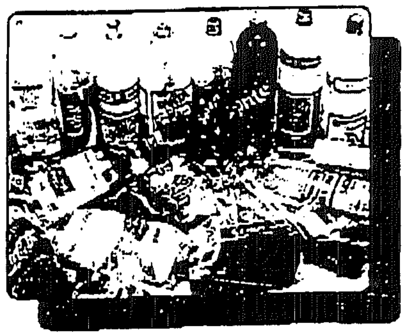
● Realizzati nelle versioni 500 e 1000 Kg./h. sono adatti al recupero di scarti industriali, agricoli e rifiuti urbani con alte percentuali di contaminazione, sono abbinabili agli impianti RF della stessa grandezza.
Questi tipi di impianti differiscono dai COMPACT nel maggior numero di cicli di lavaggio, separazione e risciacquo e nella più alta intensità ed accuratezza di separazione dei contaminanti.
Anche in questi impianti le essicazioni possono essere a richiesta a gas, elettriche o a vapore.
La produzione ed il consumo dell'acqua dipendono dagli spessori e dalle contaminazioni dei materiali processati.

sorema

PLASTICS RECYCLING SYSTEMS

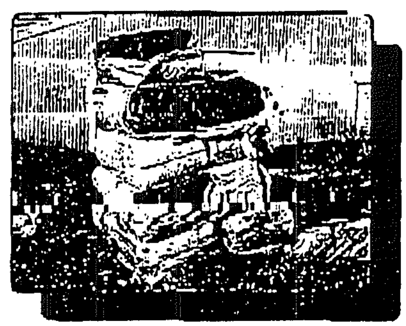
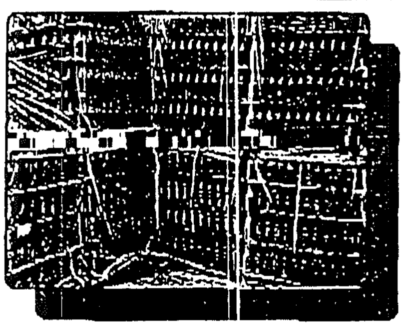
PLASTICS RECYCLING SYSTEMS

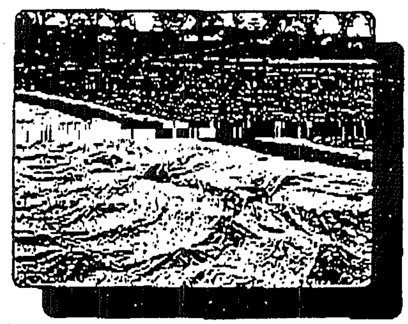



- Recycling products
- Produits recyclables
  Rückgewinnende Produkte
- Productos reciclables
- Prodotti riciclabili





sorema

● Sorema plants
● Installations Sorema
Sorema Anlagen

● Complete lines for recycling plastic materials coming from industrial, agricultural and urban wastes.
Available in the following capacities: 100 - 250 - 500 - 1000 - 2000 Kg./hr.
Versions for clean, slightly dirty, average and highly contaminated wastes.
Recycling factories on a turnkey basis.
Storage and forced feeding systems for film and ground fibre, adaptable to all types of extruder from Ø 60 to Ø 200 mm.
Storage, mixing, transport, weighing, bag filling, colouring, additivating and charging of powder systems for recycled materials.
Particular problems examined.
Depositaries highly experienced in this sector, working purely in creating and developing new technologies for extremely flexible and reliable plants, patented in all industrial countries.
Profit in this sector comes from three essential components.
Containing the cost of the material bought in; plants which can easily separate all types of contamination such as paper, wood, sand, glass, ferrous and non-ferrous metals, dust, ABS, PS, PVC, etc., allowing supply sources to be extended and reducing costs; containing energy costs: the basic, if not the main component to the production cost.
Sorema has invested, is investing, and will continue to invest considerable human and monetary resources in developing systems which are more and more efficient and specialized.
Our plurennial experience means that when we put a plant on the market its reliability is without equal, both from the mechanical point of view, with all its oversized organs, the quality of the component engineering picked from the best the market has to offer, and from the process point of view.
Our company does not only supply plants, but looks after the customer right from the first contact, examining the layout, civil works, market research, purchasing and sales sources, staff training for the ordinary and extraordinary plant running, suggesting all developed technological innovations to him.
And we do not stop once he has taken delivery. We continue to keep him up-to-date, feeding him with all the latest technological information so that he can keep his plant modern and competitive and thus able to exploit all new opportunities.

● Lignes complètes pour la récupération de matières plastiques provenant de déchets industriels, agricoles et ordures ménagères avec capacité de: 100 - 250 - 500 - 1000 - 2000 Kg./h. dans les versions pour déchets propres, ou bien légèrement, moyennement ou hautement contaminés.
Usines 'clés en main' de régénération.
Systèmes de stockage et alimentation forcée pour film et fibre moulue pouvant s'adapter à n'importe quel type d'extrudeuse de 60 à 200 mms. de Ø.
Systèmes de mise en silos, mixage, transport, pesage, ensachage, coloration, additivation et chargement des matériaux recyclés.
Sur demande, des problèmes particuliers sont étudiés.
Dépositaires de la plus longue expérience dans ce secteur dans lequel elle opère exclusivement pour la réalisation et le développement de nouvelles technologies dans des installations extrêmement flexibles et fiables, brevetées dans tous les pays industriels.
Le bénéfice dans ce secteur provient des trois éléments suivants.
Contrôle dans le coût du matériel acquis; installations capable de séparer sans difficulté tout genre de contamination tel que papier, bois, sable, verre, graisse, métaux ferreux et non-ferreux, poussière, ABS, PS, PVC etc., lesquels permettent de rendre plus amples les sources d'approvisionnement en en réduisant le coût; modération du coût énergétique qui est le composant fondamental sinon le principal des coûts de production.
La Sorema a investi et continue à engager d'importants resources économiques et humaines pour le développement de systèmes toujours plus efficients et exclusifs.
Notre expérience plus que décennale nous permet de présenter sur le marché des installations ayant un degré de fiabilité inégalable: soit du point de vue mécanique, pour l'extrème précision dimensionnelle de tous ses organes, pour la qualité de ses composants choisis parmi les meilleurs du marché, soit pour le procédé utilisé.
Notre société ne se limite pas uniquement à la simple fourniture des installations, mais elle suit son client depuis les premières phases d'étude du layout, des oeuvres civiles à la recherche du marché, des sources d'approvisionnement et de vente, à l'instruction du personnel pour la gestion ordinaire et extraordinaire de l'installation, en lui proposant toute innovation technologique développée.
Ensuite, pour que l'installation soit maintenue toujours plus à la page et compétitive en rapport également avec les secteurs renouvelés d'exploitation.

Komplette Linien für die Rückgewinnung von Industrie — und Landwirtschaft-Abfällen und Stadtmüll stammenden Kunststoff-Materials mit Produktionskapazitäten von: 100 - 250 - 500 - 1000 - 2000 Kg./h, mit den Versionen für reine, leicht, mittel oder stark verschmutzte Abfälle.
Schlüsselfertige Regenerationswerke.
Lagerungssysteme und Stopftrichter für Film und zerkleinerte Fasern, anpaßbar an jede Art von Extruder mit Ø von 60 bis 200 mm.
Systeme für Insilolagerung, Mischen, Transport, Wägen, Insäckepacken für Farb-, Additivier- und Ladesysteme des regenerierten Materials.
Auf Wunsch werden besondere Probleme entwickelt.
Inhaber der längsten Erfahrung auf diesem Sektor, auf dem sie ausschließlich für die Realisierung und für die Entwicklung neuer Technologien in außerordentlich flexiblen und zuverlässigen, in allen Industrieländern patentierten Anlagen tätig sind.
Der Nutzen auf diesem Sektor entsteht durch diese Hauptkomponenten. Kostenverminderung des erworbenen Werkstoffes: Anlagen, die ohne Schwierigkeit jede Art von Verschmutzung abtrennen können, wie Papier, Holz, Sand, Glas, Fett, Eisen- und Nichteisenmetalle, Staub, ABS, PS, PVC usw., die es ermöglichen, bei Verminderung