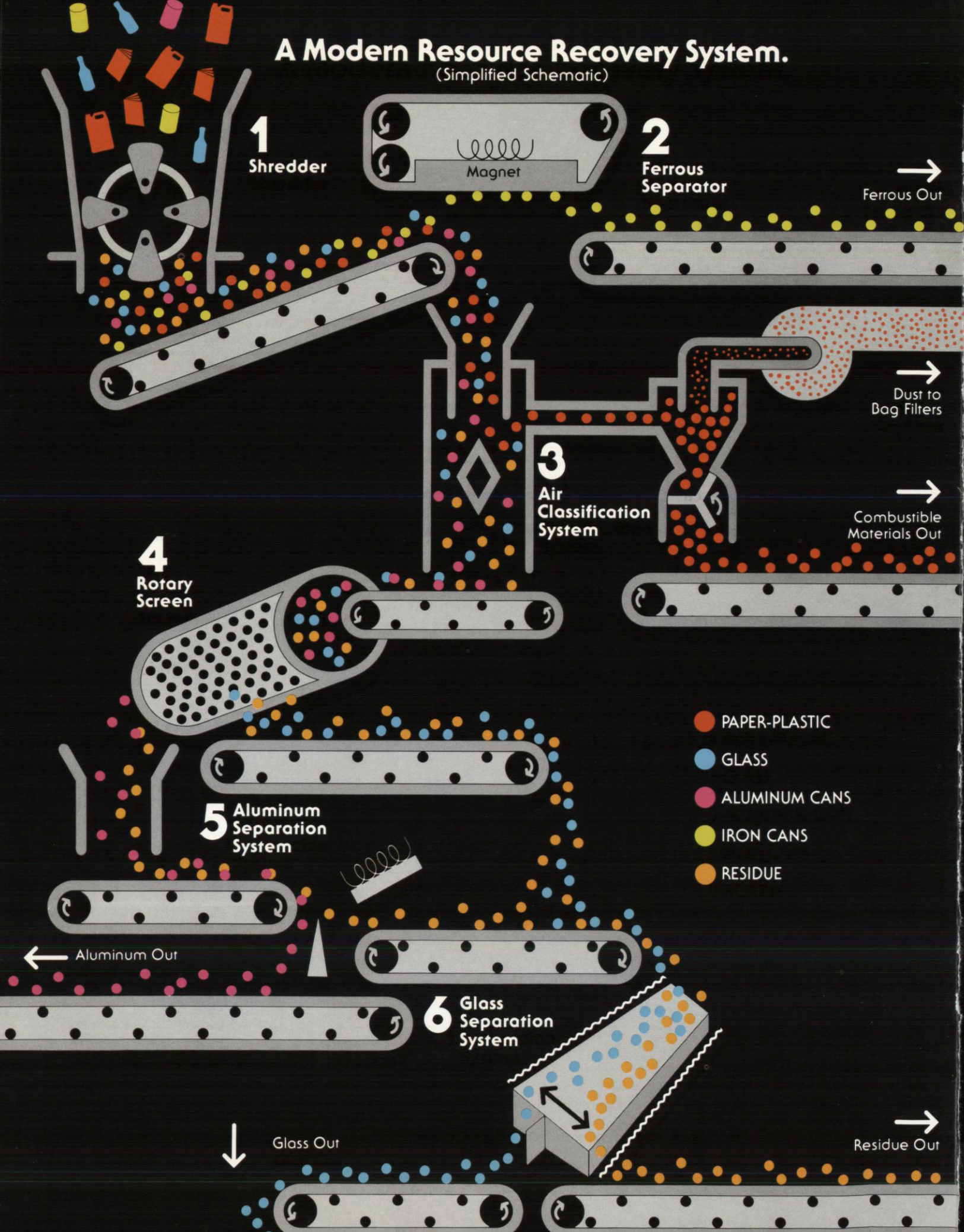
TeledyneReport

second quarter 1978

Urban Waste: Turning a Problem into a Valuable Resource


A Modern Resource Recovery System.
(Simplified Schematic)
1
Shredder
Magnet
2
Ferrous
Separator
Ferrous Out
Dust to
Bag Filters
3
Air
Classification
System
Combustible
Materials Out
4
Rotary
Screen
PAPER-PLASTIC
GLASS
ALUMINUM CANS
IRON CANS
RESIDUE
5
Aluminum
Separation
System
Aluminum Out
6
Glass
Separation
System
Glass Out
Residue Out

We're creating it at the rate of more than a hundred million tons a year, and throwing away some of our most valuable resources.

We call it trash, rubbish, junk, garbage, refuse, or less emotionally, urban waste. Throughout the years we have burned it, buried it, and jettisoned it at sea. In our efforts to be rid of it we have even wondered hopefully if it could be launched into interplanetary space, never to return.

Waste has been a problem of civilizations since ancient times. Some societies simply moved to a new location when the problem became too great, or built new villages on top of old waste heaps. These accumulations of centuries have become rich sources of information on how earlier civilizations lived.

Now, however, because of the great variety of waste products we produce, and the huge size of many of our cities, urban waste threatens to bury us—economically, at least—and our cities as well.

The problem is compounded by our modern love affair with convenience living. Not much more than a century ago many commodities were sold in bulk form and buyers brought their own reusable containers to carry them. More recently, bottles were almost universally returned for re-use and refund of a deposit. Cans were once nearly all made of tin-plated iron that could be counted on to rust away quickly.

On the Cover: Major resources that can be derived from urban waste are symbolized: Metals, energy, fertilizer and building materials.

The more modern packaging materials of today, such as aluminum, plastics and various treated paper products behave differently. If they are buried or thrown on a heap they are virtually indestructible. They just last and last. And no matter how deep the hole is into which they are thrown, they will eventually fill it and overflow it, and another hole must be found. Unfortunately, in many urban areas, we are running out of holes, and the cost of trucking refuse long distances is rapidly getting out of hand.

WASTED RESOURCES

The burn and bury method of urban waste disposal is not only expensive, land-consuming, and often polluting, it is wasteful of our limited resources. It is estimated that in the average ton of urban waste there are 140 pounds of good quality ferrous metals (worth about $2.00 at current prices), 10 pounds of high quality aluminum (also worth about $2.00) and enough combustible materials to supply about 7.5 million BTU's of heat energy, equivalent to about 50 gallons of number 6 fuel oil.

Even the glass and other inert, non-combustible residue has been found to be a useful material for aggregate in cement building blocks, insulating panels, road-surfacing and cast resin/glass sewer piping.

These figures become more meaningful when one projects them into the frame of reference of a city such as New York, which generates an estimated 6 million tons of waste each year. If the average content of useful materials in that waste is the same as we estimated for our average ton, it means that about 400,000 tons of ferrous metals, 30,000 tons of aluminum, the heat equivalent of 7 million barrels of oil, and more than 500,000 tons of useful aggregate material (glass) are being thrown away each year, by that city alone.

The figures become mind-boggling when you consider that the total amount of urban waste generated in the United States is believed to be about 140 million tons each year. It has been estimated that it costs at least one and a half billion dollars annually to collect and dispose of these wastes in the conventional manner. To this cost must be added the value of the useful materials that are lost.

SAVING MATERIALS AND ENERGY

There are better ways of coping with this avalanche of useful materials in useless form that we call urban waste. The problem has been to devise economically feasible and technologically practical methods of turning waste back into resources. Teledyne National is historically one of the most successful leaders in developing practical and economical methods of separating, recovering and marketing the useful components in trash and using the resultant income to lower the cost of waste removal.

Teledyne became interested in these problems in 1970 and launched a research and development program to see what useful products could be made from all this waste. Because the largest fraction of urban waste (up to 80%) is paper, cardboard and plastic, it was decided to concentrate on this.

The result, in the early 1970's, was a family of products made by combining this material in fiberized or finely shredded form with a urea formaldehyde or phenol formaldehyde binder and hot pressing it into building panels. These panels were similar to particle board and had the same basic applications—floor underlayments, door cores, wall panels—and could be made with existing production machinery.

The oil embargo that began in October 1973 and the rising cost of fuel oil made the cellulosic and plastic content more valuable as a fuel than as a structural material. Teledyne, consequently, undertook research on the most efficient methods of extracting and using this fraction as a fuel.

NEW PRODUCTS FROM WASTE GLASS

Glass makes up from six to eleven percent of the waste stream in most urban areas, and this was the second major area of reclamation that Teledyne investigated. Waste glass must be free of ceramic material and sorted by color to be used by the glass industry, and this is too costly for an urban waste recovery system. Alternate uses were researched by Teledyne and two promising types of products were developed.

One product, developed in conjunction with the ceramics laboratory at the University of California, Los Angeles, is foam glass, a material ideal for insulation panels and lightweight aggregate for concrete and concrete blocks.

The material is made by grinding the glass to a fine powder, mixing it with a percentage of fly-ash, which is a waste product from combustion processes, and adding a foaming agent. The combined material is then either formed into pellets if aggregate is desired, or filled into molds to make insulating building panels or pipe insulation. The material is fired in a kiln for a short time and comes out as a hard rigid foam material. The product is lightweight, fireproof and has excellent sound and thermal insulation properties. The aggregate can be mixed with cement as a substitute for sand and gravel to make concrete or concrete building blocks which combine improved insulating properties with strength and light weight.

The second area of development involves combining crushed glass with a combination of polyester and polystyrene polymers that are cured to form a hard, dense

corrosion-resistant material. One use is for sewer pipe that is lighter in weight and cheaper than concrete or fired clay pipe, more corrosion resistant and less porous. This product was developed by Teledyne in cooperation with the Brookhaven National Laboratories, and samples have been under field test since 1972.

In developing these products, Teledyne was involved solely in making products from materials collected and produced by others, but it quickly became clear that in order to control product quality, control of the separation process itself was needed.

RECOVERING VALUABLE RESOURCES

In 1972, Teledyne entered the waste separation field as well. Through negotiations with the Maryland Environmental Service and the Baltimore County Government, Teledyne was chosen to design, construct and manage a new waste processing facility for Baltimore County which would ultimately be capable of handling peak loads of 1500 tons per day or sustained loads of 1200 tons per day. The facility was designed to separate and reclaim the useful materials and develop dependable markets for them which would help defray the costs of the facility. The plant was completed and accepted its first truckload of waste in January 1976.

Teledyne's philosophy in designing the Baltimore County facility was not to attempt to develop new, untried exotic technology to cope with the problem. Instead, the best of existing machinery that had a proven track record was engineered into a complete well-integrated system.

THE MARYLAND FACILITY

The Maryland Environmental Service/Baltimore County Resource Recovery facility, located at Cockeysville, Maryland, looks like a modern well-designed manufacturing plant. The beige and blue steel buildings are clustered in the center of an oval roadway that circles the facility like a race track and provides an efficient one-way traffic pattern for the collection vehicles to enter, unload and leave.

Each collection vehicle is first checked at an automated weighing station that keeps track of the total amount of waste processed each day.

The trucks are then directed to one of six unloading bays, where they back over a movable bridge and empty their contents into receiving pits equipped with hydraulic rams. These push pits, as they are called, feed the refuse into two separate shredders that reduce all the incoming material—from kitchen refuse to upholstered sofas and automobile tires—to pieces five inches or less across.

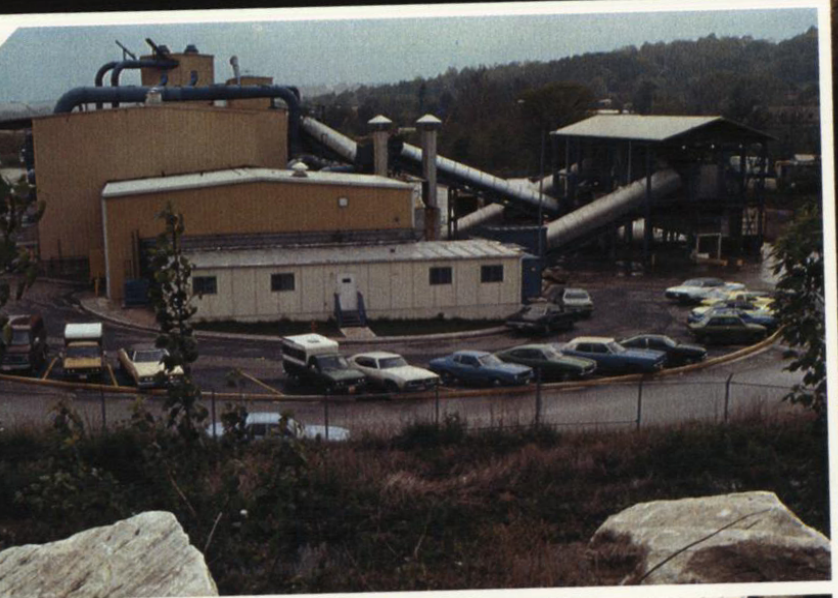
The movable bridge system spans a 500-ton storage pit into which incoming refuse can be dumped when peak loads are arriving or in the event that one of the shredders must be shut down for emergency maintenance. By moving the bridges laterally, the line operator can allocate the incoming material to the various push pits while allowing access to the storage pit. An overhead traveling crane can move the length of the storage pit and transfer material into the push pits with a five cubic yard grapple.

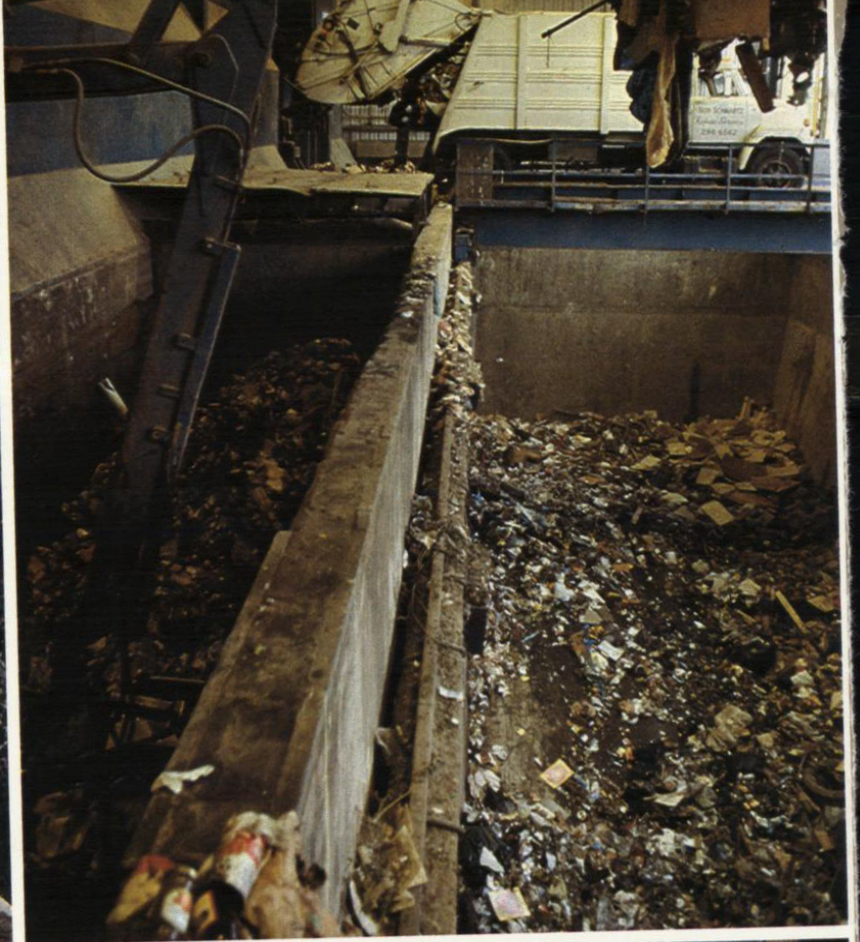
MECHANICAL SHREDDING

Input to each shredder line is monitored and controlled by an operator who sits in an environmentally protected control pod overlooking the receiving area, just above the shredder input. A compact control console permits him to operate the hydraulic rams of the push pits, and to start or stop the shredders, conveyor belts and other machinery in his processing line, as well as to monitor the safety and operational status of all equipment. He also controls a smaller grapple crane that can remove and set aside items that might be damaging to the system such as automotive engine blocks. Each of these operators also has a video screen which can be switched to show various views of the processing line through closed-circuit television cameras.

The shredders consist of large rotating steel cylinders with rows of heavy steel weights hinged to their periphery. These swinging hammers batter the incoming material and force it through a heavy steel grate when it has been reduced in size.

How Resources are Recovered from Refuse.





D:

A: This modern resource recovery facility at Cockeysville, Maryland was designed and is operated by Teledyne National for the Maryland Environmental Service and Baltimore County. With a peak load capacity of 1500 tons of refuse per day, it can separate and recover ferrous metals, aluminum, combustibles and glass.

C: Each shredder line is controlled by an operator who sits in an environmentally protected control pod that overlooks the receiving area. He can observe various points in the separation process through closed-circuit TV and start and stop all machinery with a small control console.

D: Collection trucks back over movable bridges to dump refuse into push pits that feed two separate shredder lines. Overflow pit at right side can hold up to 500 tons of refuse during peak delivery periods if necessary.

D: Refuse derived fuel production and the status of related equipment are monitored from a central plant control room that includes a closed-circuit television system.

E:

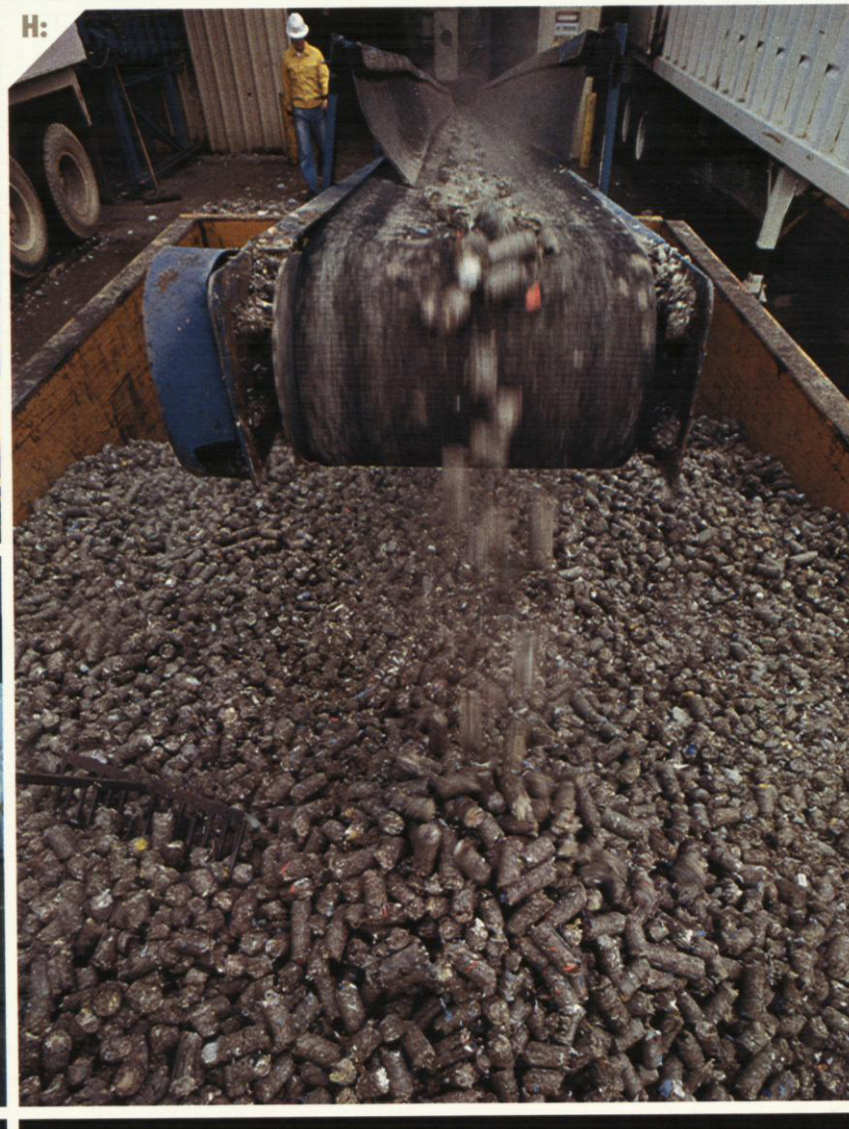
F:

G:

E: This is one of two 1000 horsepower shredders, each of which can process up to 100 tons of refuse per hour. The refuse enters the shredder at the top from the push pits which are located on the floor above. Shredded material is discharged at the bottom.

F: Ferrous metals are plucked up from the lower conveyor belt by a series of large electromagnets at the top. A second conveyor belt carries the material to a hopper from which it drops into an open-top trailer.

H:



G: Lightweight combustible materials such as paper, plastics and garden trimmings are removed by an air classification system that resembles a vertical wind tunnel. A powerful air draft is provided by two large exhaust fans at top left and right, each taller than a man.

H: Combustible materials may be used as a fuel in their original shredded form in many types of furnaces. For certain applications, compacting the material into dense pellets about an inch in diameter simplifies transportation and storage.

I: Aluminum, though not a magnetic material itself, is separated from other materials by an electromagnetic method. Eddy currents, induced in the aluminum by a strong magnetic field create their own opposing magnetic fields that cause the aluminum to be repelled.

K: Shredded refuse, even if all recoverable materials have not been removed, compacts more readily and is far more ecologically acceptable when used in landfill than conventional unprocessed refuse.

J: Glass is separated from other residue by a vibrating air-table that sorts material according to its specific gravity and shape. Foam glass and glass polymer composite materials derived from waste glass have useful applications in building and construction.

L: Shredded cellulosic refuse, when combined with non-industrial sewage sludge, composts into an excellent farm and garden fertilizer in about 50 days. This portable rotary screen is used to remove undigested material from the finished compost.

MAGNETIC SEPARATION

The shredded material is then carried by a conveyor belt to the top of a large tower outside the main building, where the first and most easily separated material is removed. This consists of iron and steel material—cans, wire, discarded automotive parts and the like—which are snatched up from the conveyor belt by powerful electromagnets, and conveyed to a waiting open-topped truck trailer. This material is sold to a steel company for recycling. It may also be sold to a de-tinning company for recovery of the valuable tin plating before the iron and steel is recycled.

REMOVING COMBUSTIBLES

The remaining refuse is returned to the main building where the combustible material is removed. This is accomplished in an air classification system that resembles a vertical wind tunnel. The refuse enters through a port in the top of a vertical cylinder that is almost two stories high. Two powerful centrifugal air pumps suck air out of the cylinder through ports near the top. Air enters at the bottom creating a strong upward moving current of air inside the cylinder. Materials such as glass, rubble, aluminum cans and other non-ferrous metals are heavy enough to fall through the air stream and leave the cylinder at the bottom, where they fall onto a conveyor belt that carries them away. Lighter materials such as paper, cardboard, plastic, rags, shredded wood, leaves and lawn clippings are carried up by the air stream and leave through the large ducts that provide the air suction.

This lighter material is separated from the air stream by conventional cyclone type separators. These devices produce a whirling rotary air circulation in a cone-like chamber that causes the entrained material to be thrown to the periphery where it can fall to the bottom of the chamber and leave the separator through a rotary air lock.

The air, still containing a small amount of finely divided material and dust, leaves the separator near the top and is ducted to a large bag house where the dust is trapped in large fabric bags much as it is in a vacuum cleaner.

FUEL OR FERTILIZER

The combustible fraction that has been separated can be used in several ways. In its original state, with pieces up to five inches across, it can be burned in boilers with specially-designed grates to provide heat for industrial use, steam for heating or steam to drive a turbine for generating electricity. The material can also be shredded a second time to reduce it to pieces less than an inch across that can be burned in suspension in conventional boilers. Another application for the combustible material is to use it to burn or pyrolize sewage sludge while producing useful steam. This application is called co-disposal.

The combustible fraction can also be used in an important non-fuel application. When it is screened and mixed with non-industrial sewage sludge, the material composts into an excellent garden and farm fertilizer in about 50 days. The method thus converts two materials that must be disposed of into a useful product. The Maryland Environmental Service and the United States Department of Agriculture have pioneered this method and are currently operating a composting facility near Washington, D.C.

SAVING ALUMINUM AND GLASS

The heavy fraction that remains after the light combustible material has been removed consists primarily of aluminum cans, glass fragments and miscellaneous residue. The aluminum is removed next in an eddy current separator. The refuse falls through a strong electromagnetic field which induces powerful electrical currents in the aluminum material. These currents create their own opposing magnetic fields that cause the cans to be repelled by the electromagnet onto a conveyor belt for removal. Nonconductive materials such as glass are unaffected by the magnetic field and fall straight through to another conveyor belt. While the aluminum material forms a small percent of the waste stream, it brings up to $400 a ton for recycling.

Glass is the remaining salvageable material. It is separated from stones and organic material on the basis of its specific gravity and, to some extent, its shape. The material falls onto a slanted table that vibrates rapidly along one axis. The table is perforated with many small holes through which compressed air passes to make the material act as a fluid. The result is that the heavier glass particles migrate to one side as they slide down the table and the lighter residue material migrates to the other. Each falls into a separate chute for collection.

The residue is hauled to a sanitary landfill for disposal. When all of the salvageable materials are removed, this residue accounts for only about 5 to 15 percent by volume of the total incoming waste, thus greatly extending the life of existing landfill sites. Even if glass and combustibles are disposed of in landfill, the shredded material handles and compacts more easily and results in a far more ecologically acceptable disposal method than the old-fashioned "garbage dump".

OTHER TELEDYNE PROJECTS

Teledyne National is involved in a number of other waste disposal and resource recovery projects throughout the country. In addition to operating the citizens' disposal area for the Cockeysville plant, Teledyne has just completed a transfer facility in Baltimore County that will further reduce the cost of refuse collection. Conventional neighborhood collection trucks bring refuse to the centrally located transfer station from the more remote parts of the county. Here it is dumped into push pits and hydraulically compacted into large truck trailers which will hold the contents of 3 to 6 collection trucks. These trailers are then taken to the Cockeysville facility, achieving a considerable economy in time and fuel for the collection fleet.

Teledyne National is also designing a second resource recovery plant for Baltimore County that will serve the remainder of the county.

In Akron, Ohio, Teledyne is now managing the construction of a resource recovery facility which will separate combustible material and burn it at the site in special boilers to provide steam to the downtown area of Akron through an existing steam distribution loop. Additional steam lines will provide steam to several hospitals, to the University of Akron and to industrial users. Teledyne will operate the facility for the City of Akron much in the manner of a utility, billing customers for steam used. Of the remaining refuse, initially only the ferrous material will be recovered, but there are plans to recover aluminum and glass at a later date.

Teledyne National also recently began the design of a facility for Southeastern Massachusetts that will process 1200 or more tons of refuse a day, burn the combustibles at the site and use the steam to generate electricity that will be fed into the local electrical utility grid. Waste steam will also be sold to companies in a contiguous industrial park. The plant is expected to be operational in 1981.

Still another recently awarded project is the conversion of an existing incineration/landfill facility in Ogden, Utah into a full-fledged resource recovery system that will provide refuse derived fuel as well as reclaimed materials.

Teledyne National has the greatest amount of successful "hands-on" operating experience in this rapidly growing field, which is solving both the problem of coping with urban waste and the problem of conserving our limited resources of fuel and materials. It is interesting that the Baltimore County facility is estimated to show an energy balance of 18 to 1. In other words it takes only one unit of energy to recover 18 units of energy, either in usable fuel, or in energy saved that would be required to refine the recovered materials from scratch.

Not only do programs such as these recover valuable resources and have a beneficial effect on our environment, but the revenue derived from selling the recovered resources can be used to lower the overall cost of waste disposal in our society.

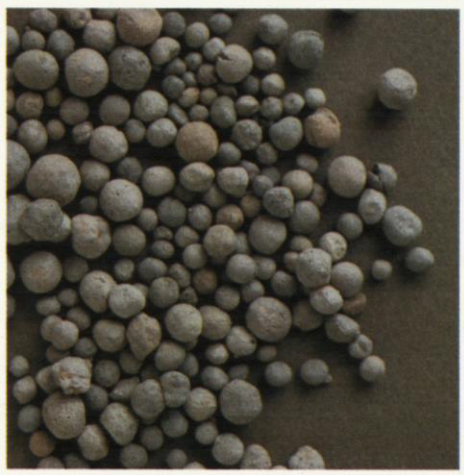
Innovative Products from Waste.

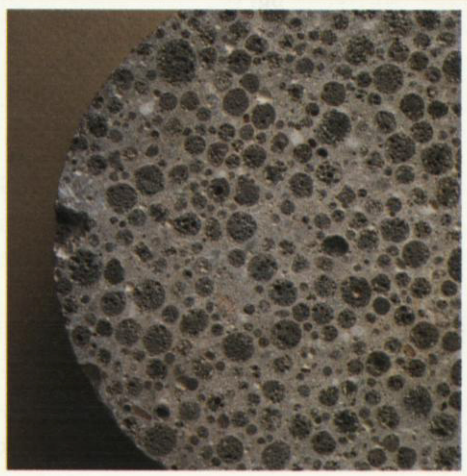
LEFT:

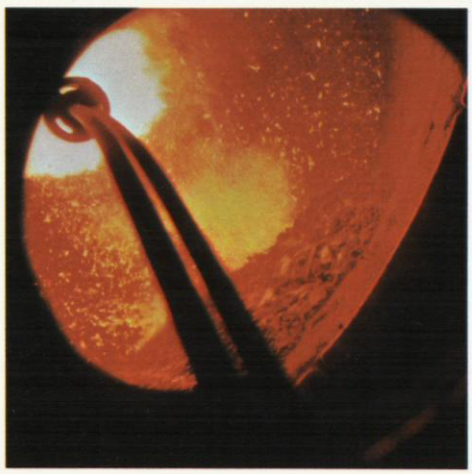
Glass, typically six to eleven percent of urban waste, can be recovered economically and used to manufacture a variety of products for the building and construction industry.

BELOW, CENTER:

A superior lightweight aggregate for use in concrete and concrete blocks is made from waste glass by a patented process.







ABOVE:

Test cylinders made with foam glass lightweight aggregate show excellent compression strength. The cellular nature of the aggregate shown in this cross section contributes to the high strength to weight ratio of the concrete.

LEFT:

Another product combines waste glass with polymeric resins to make corrosion-resistant sewer pipe that is stronger than conventional concrete or fired-clay products.

ABOVE, TOP:

Combustible material makes up as much as 80 percent of urban waste. It is a useful fuel that can be used in shredded form, or compressed into dense pellets (center) for easier transport and storage.

ABOVE, BOTTOM:

Shredded material is burned here in suspension to provide process heat for making expanded shale aggregate used in the cement industry.

LEFT:

Waste glass can also be made into lightweight foam glass panels, pipe insulation, and similar building products that are fireproof and provide excellent thermal and acoustic insulation.

Teledyne, Inc. and Subsidiaries

Consolidated Statements of Income

	Three Months Ended June 30,		Six Months Ended June 30,	
	1978	1977	1978	1977
Consolidated Sales	**$621,412,000**	$524,637,000	**$1,199,433,000**	$1,070,496,000
Consolidated Costs and Expenses:				
Cost of sales	**463,116,000**	392,165,000	**896,921,000**	798,398,000
Selling and administrative expenses	**70,994,000**	66,791,000	**144,145,000**	133,571,000
Interest expense	**3,852,000**	4,166,000	**8,075,000**	8,531,000
Interest income	**(2,726,000)**	(2,331,000)	**(6,986,000)**	(4,948,000)
Provision for income taxes	**44,400,000**	32,400,000	**81,200,000**	69,300,000
	579,636,000	493,191,000	**1,123,355,000**	1,004,852,000
Income of Consolidated Companies	**41,776,000**	31,446,000	**76,078,000**	65,644,000
Equity in Net Income (Loss) of Unconsolidated Subsidiaries, after allocated interest expense and income tax items (excludes equity in unrealized appreciation (depreciation) on marketable equity securities)	**24,036,000**	(3,788,000)	**42,390,000**	8,559,000
Net Income	**$ 65,812,000**	$ 27,658,000	**$ 118,468,000**	$ 74,203,000
Net Income Per Share	**$5.04**	$2.09	**$9.04**	$5.62

NOTE—The consolidated statements of income for the six months and three months ended June 30, 1977 have been restated to reflect the use of equity accounting for certain investments owned by the Company's unconsolidated subsidiaries. The use of equity accounting increased equity in net income of unconsolidated subsidiaries and net income by $7,599,000 ($0.58 per share) and $4,285,000 ($0.33 per share) in the six months and three months ended June 30, 1978, respectively, and by $4,802,000 ($0.37 per share) and $2,373,000 ($0.18 per share) in the six months and three months ended June 30, 1977, respectively. In addition, the results of operations for the three months ended March 31, 1978 have been restated to reflect the use of equity accounting for the investment in Reichhold Chemicals, Inc. The effect was to increase equity in net income of unconsolidated subsidiaries and net income for that quarter by $314,000, or $0.02 per share.

Consolidated Balance Sheet

	June 30, 1978
ASSETS	
Current Assets:	
Cash and marketable securities	$ 168,684,000
Receivables	284,729,000
Inventories	174,609,000
Prepaid expenses	4,882,000
Total current assets	632,904,000
Investments in Unconsolidated Subsidiaries	485,442,000
Property and Equipment, less accumulated depreciation of $310,377,000	263,159,000
Other Assets	36,253,000
	$1,417,758,000
LIABILITIES	
Current Liabilities:	
Accounts payable	$ 87,796,000
Accrued liabilities	177,628,000
Accrued income taxes	29,000,000
Current portion of long-term debt	6,363,000
Total current liabilities	300,787,000
Long-Term Debt	282,233,000
Other Long-Term Liabilities	74,096,000
Shareholders' Equity	760,642,000
	$1,417,758,000

Review

QUARTER AND FIRST HALF RESULTS

Net income for the second quarter ended June 30, 1978 was $65,812,000 compared to $27,658,000 for last year's second quarter. Per share net income for the quarter was $5.04 versus $2.09 last year. Consolidated quarterly sales increased to $621,412,000 from $524,637,000 in the 1977 period.

For the six months ended June 30, net income was $118,468,000 or $9.04 per share versus $74,203,000 or $5.62 per share for the first six months of 1977. Consolidated sales increased to $1,199,433,000 for the six months from $1,070,496,000 for the first half of last year.

Equity in net income of unconsolidated subsidiaries was a record for the quarter and six months. Argonaut Insurance Company experienced a loss in last year's second quarter due to adverse development in reinsurance assumed, but is now operating profitably. Results at United Insurance Company of America were also ahead of last year, when additional reserves on accident and health policies were provided in the second quarter.

On June 2, a 10% common stock dividend was paid to shareholders of record May 8.

There were 13,048,209 average shares outstanding during the quarter.

NEW DRAFTING MATERIALS

Teledyne has added two new products to their already broad-based line of drafting room materials and equipment.

Teledyne Rotolite has introduced a whiteprinter, specially made for the reproduction of data logged at oil drilling sites. It was designed to meet the critical space requirements of on-site drilling facilities and is both compact and light, weighing less than 40 pounds. The logger has no heat exhaust or ozone discharge, which eliminates any requirement for venting.

Teledyne Post has added a new diazo film for drafting reproduction which can be used in pressure development or ammonia whiteprint machines for duplicating engineering originals.

The new film image will not bleed or smear and can be removed easily with a moist vinyl eraser or Telegel,™ a proprietary image removal fluid. Corrections or changes can be made using a technical pen or drafting pencil.

PRESERVING GREEK ARTIFACTS

Meteorological instruments made by Teledyne Geotech will be used in a major study by the Greek government involving air pollution and its effect on the Parthenon and other historic sites in and around Athens. The basic problem is the deterioration of the marble in the buildings and statues caused by industrial and automobile waste gases.

Teledyne's instruments will allow scientists to determine where the pollutants come from, how they are concentrated or dispersed, under what conditions maximum or minimum concentration occurs and what air quality standards will be necessary to abate the problem.

Commercial air quality analyzers will measure the concentration of pollutants in the air. All data will feed into a Teledyne Geotech digital acquisition, processing and recording system, where the information will be stored on magnetic tape. Additional Teledyne equipment will be added later in the program.

CONTROL® BRUSH AND FOUNTAIN-FILTER INTRODUCED BY TELEDYNE WATER PIK

Newly developed products from Teledyne Water Pik include a toothbrush and an attachment for the Instapure® water filter which converts it into a drinking fountain.

Named the Control Brush, the toothbrush features a scientifically designed handle which adapts to whatever grip or brushing technique dentists recommend. In their studies of the way people brush their teeth, Teledyne found that it is the handle, not the bristles, that is to blame for poor brushing.

The handle of the brush is octagon shaped, the same as handles on dental instruments, and is noticeably longer. By adding length and a better gripping surface, studies have shown that the brush gives the user maximum control without placing a strain on his hand.

With the Control Brush, it will be more convenient for adults as well as children to brush longer and more efficiently.

The new fountain-filter attachment for the Instapure® water filter is not only convenient but also conserves water by eliminating the need to wash and rinse a glass. It consists of a taller filter and an easy push button spout which replaces the regular filter and cover. Because of the taller filter, the fountain attachment also offers a longer filter life—up to six months or 400 gallons.

Fountain Attachment For Instapure Water Filter

Teledyne Water Pik Control Brush

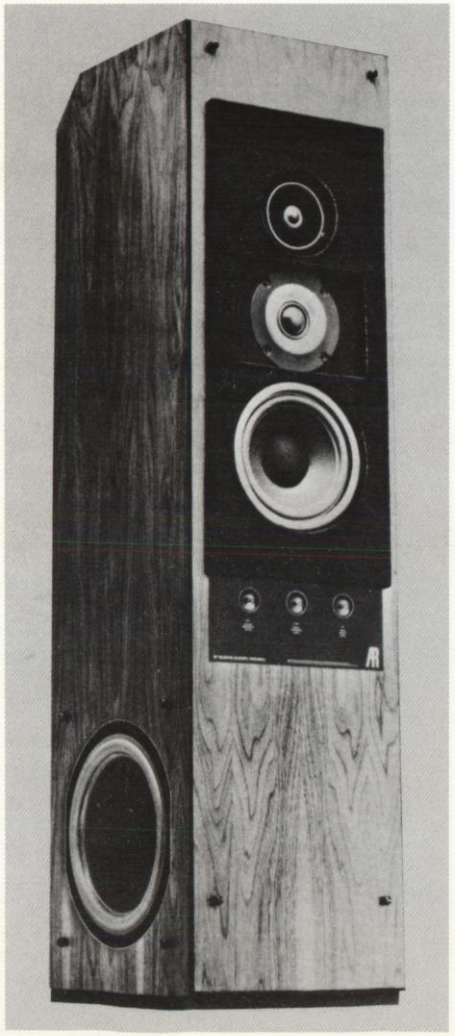
NEW AR9 STEREO SPEAKER

Teledyne Acoustic Research is now delivering their newest and largest stereo speaker which was introduced at a trade show early this year. The new speaker, called the AR9, is a floor standing, 4-way, 5-driver system with the flattest and widest frequency response of any speaker Teledyne has ever produced. It also has the greatest power handling capacity of the AR line.

The speaker measures approximately 4-1/2 feet high, 15 inches wide, 15 inches deep and weighs 130 pounds. The cabinet is a finished walnut-veneer with a black, snap-on cloth grille that covers the entire front surface.

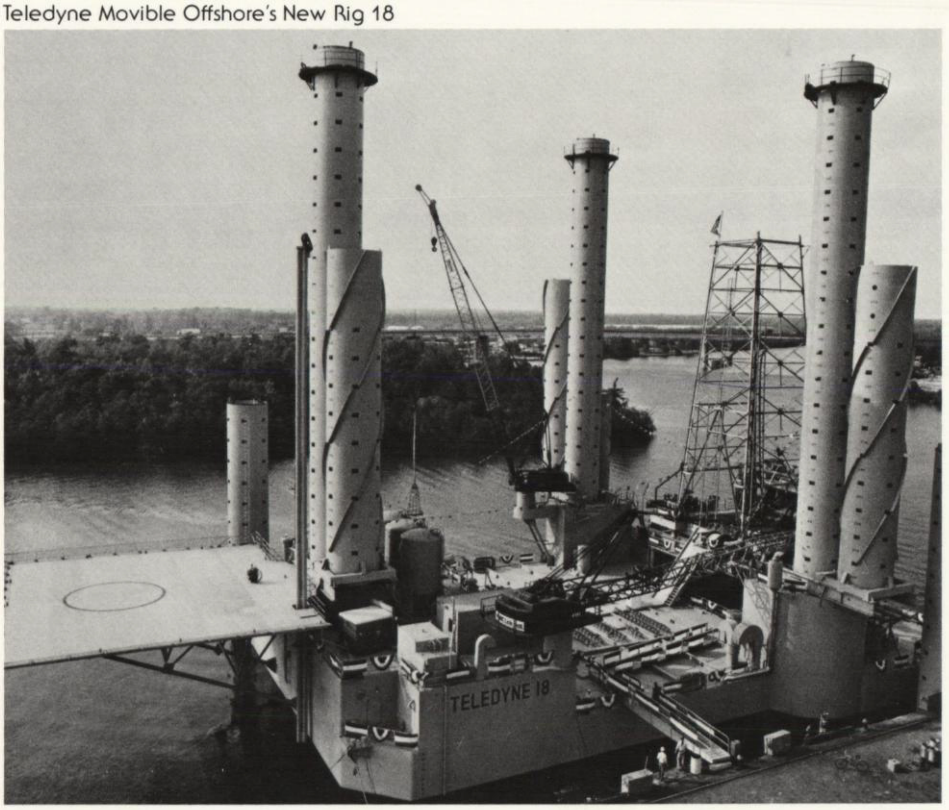
Among the innovations included in the design of the AR9 is the AR Acoustic Blanket™ which effectively absorbs cabinet reflection.

The speaker was designed to come as close to the optimum speaker system as could be designed under the present state of the art.



New AR 9 Speaker, Cloth Grille Removed

Teledyne Movible Offshore's New Rig 18



NEW DRILLING RIG OPERATING

Teledyne Movible Offshore announced that a new offshore oil drilling rig, christened in April, is on location in the Gulf of Mexico. This is the third rig of a patented design series of mat-supported jack-up platforms built for Teledyne.

The new rig's platform measures approximately 160 feet long, 130 feet wide and 15 feet deep with a 50 square foot drilling slot. Each of the three cylindrical legs are 312 feet long and 12 feet in diameter. The rig is diesel electric powered and houses 60 persons in modern, comfortable living quarters.

Due to the continuing demand for exploratory and developmental drilling in the Gulf of Mexico, Teledyne has ordered another jack-up rig, scheduled to be completed later this year.

POWER SYSTEMS FOR SATELLITES

Teledyne Energy Systems recently completed the development of a heat source assembly and space radiator for an organic Rankine cycle power system to meet the high power requirements of satellites of the 1980's. Made for the Department of Energy, the system will provide electrical output power of 500 to 2,000 watts from radioisotope generators for earth orbital satellites and interplanetary spacecraft.

The electrically-heated ground demonstration version of the new system is now in operation, using conventional electric heating. Further ground qualification testing using a radioisotope heat source is anticipated if the system is selected for a test flight. It has been designed to be compatible with NASA's Space Shuttle as well as other launch vehicles and satellites.

LIQUEFIED NATURAL GAS PLANT

Teledyne Engineering Services is helping to build one of the largest liquefied natural gas processing plants in the world.

Located on the tip of Northern Africa, the facility's pipelines stretch 800 miles into the Sahara Desert to the source of supply. The gas vapors will be compressed into a liquefied state at the new plant. The 600 to 1 ratio involved in this conversion makes it economically possible to ship large amounts of liquefied natural gas to fuel dependent areas such as New England.

Teledyne's engineer's have analyzed the plant's critical pipes and piping support systems, which must withstand the effects of the extremely cold liquid. They are also providing field engineering services at the job site.

This Teledyne Report discusses Teledyne's activities in converting refuse into energy, in recovering valuable raw materials from urban waste, and in reducing the cost and ecological impact of urban waste disposal. Teledyne National, which entered this field in 1970, designed and now operates the Maryland Environmental Service/Baltimore County Resource Recovery facility at Cockeysville, Maryland. This facility serves about forty percent of Baltimore County's households and can handle peak loads of up to 1500 tons of refuse a day. Teledyne National is also designing a second facility that will serve the balance of the county.

Other major resource recovery projects are being carried out by Teledyne National in Ohio, Massachusetts and Utah.

TELEDYNE REPORT featuring subjects of particular interest from Teledyne activities, is issued on a quarterly basis. Previous topics include:

Aerial Mapping: Digital data processing techniques applied to aerial mapping technology are making it the fastest and most economical method of surveying the earth's surface.

The Water Pik Story: Innovative products, exceptional design, precise quality control, and outstanding customer service have made Water Pik one of today's hottest consumer brands.

Dental Health: Teledyne produces many of the instruments, materials and supplies that have helped revolutionize dental care.

Space Navigation: Whether the payload is a spacecraft for Mars or a satellite for earth orbit, the first minutes of flight, under the guidance of an on-board computer, are the most critical to the success of the mission.

Analytical Instruments: Detecting and measuring small amounts of specific substances in large volumes of other materials is the key to controlling many vital processes.

1776-1976: A look back at various technologies as they were two hundred years ago, compared with the technologies of today and Teledyne's involvement in them.

Life Insurance: This largest segment of the insurance industry not only provides financial security for millions of families and individuals, but is also a major source of investment capital.

The Refractory Twins: Two high melting point metals, tungsten and molybdenum, play versatile and vital roles in every modern industrialized society.

The Instrument Makers: Teledyne's oldest company goes back 131 years. From surveying the Old West, to moon mapping and machine tool encoders, its history is the history of measuring.

Industrial Engines: Compact portable power from gasoline and diesel piston engines has taken the drudgery out of manual labor. Now the goal is to reduce noise and emissions.

Job Corps: A decade of motivating and training a half million alienated and disadvantaged young people has produced some remarkable new teaching methods... and a lot of good citizens.

Friendly Explosives: Using explosives to save lives in aircraft emergencies may sound unlikely, but it's the safest, fastest, most reliable method ever developed.

Microelectronic Hybrids: From vacuum tube to transistor to integrated circuit, the history of electronics has been one of fitting more and more complex electronic circuitry into less and less space. A hybrid microcircuit is a sophisticated form of microelectronic packaging that goes a step beyond the individual large scale integrated circuit.

The Energy Options: Nuclear fuels and coal are both abundant enough to make a significant contribution to U.S. energy needs over the next several decades. Unlike many other energy sources, the technology to use them on a large scale exists today.

Workmen's Compensation Insurance: Most working people are already protected. The goal is coverage for every employed person.

Drilling for Offshore Oil: Almost half our national resources of oil and gas are believed to lie under offshore waters. The technology for getting them out is here — but it won't be easy.

The Search for Oil: With supplies dwindling and demand growing, sophisticated geophysical techniques are being brought to bear on the problem of locating new oil deposits.

High Speed Tool Steels: These precision, premium-priced alloys are vital to the production of virtually every commodity we use in modern life.

Energy Crisis in the Computer Room: As the quality of utility electrical power falls off and brownouts and blackouts become more common, the incidence of computer failures goes up. Solid-state Uninterruptible Power Systems can solve the problem.

Raydist: This ultraprecise electronic navigation system can pinpoint locations at sea with a sensitivity of one and a half feet at ranges of up to 250 miles from base stations.

Welding: One of industry's most versatile production techniques, welding is used in the manufacture of virtually every type of fabricated metal product made today.

General Aviation Engines: Propeller driven aircraft powered by piston engines are not only alive and well more than 30 years after the advent of the jet, they dominate air activity today.

Rubber: Rubber compounds are being called on to do new technological jobs in applications ranging from industrial tires to Teledyne's new automotive bumper system that will dissipate five-mile-per-hour impacts.

Loran: Loran was one of the first all-weather electronic navigation systems. Recent Teledyne innovations have lowered costs and greatly improved its range and accuracy.

Seismology: This relatively young science has expanded from the classic study of earthquakes to become an important tool in oil and mineral exploration, detection of underground nuclear explosions and earthquake hazard reduction.

Casting: The simple process a small boy uses when he casts a tin soldier is the basis of a high technology industry that produces items ranging from turbine blades to 90-ton steel mill rolls.

AIDS: Aircraft Integrated Data Systems keep a running record of the vital functions of the new jumbo jets and provide airlines with an important tool for lowering costs associated with maintenance, fuel management and crew proficiency testing.

Thermoelectrics: Generators that convert heat directly into electricity are providing a practical new power source for applications ranging from space exploration to remote weather stations.

Thin Metals: Less becomes more when space-age metals are rolled out into thin strip and foil. These new materials, already being used in thousands of products, are making new metalworking techniques possible.

The Reproduction of Music: Men began experimenting with methods of recording sound over 150 years ago, but it remained for electronics and some very recent developments to allow music to be reproduced with concert-hall realism.

The Crowded Spectrum: The lower portion of the radio spectrum is already overcrowded with hundreds of wireless services. Microwave devices such as the traveling wave tube are opening higher frequencies for practical use.

Science and Cinematography: Modern techniques of slow motion cinematography let scientists and engineers analyze actions and events that happen too fast for the eye to follow.

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