TIRE-DERIVED FUEL/RESOURCE RECOVERY SYSTEMS

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ADVANTAGES OF

TDF/RESOURCE RECOVERY SYSTEMS

- ONE SYSTEM DISPOSES OF BOTH MSW AND TIRES BY BURNING IN RDF BOILERS

- SINCE TDF GENERALLY REPRESENTS ONLY 1 TO 2 PERCENT OF WASTE STREAM IT HAS NEGLIGIBLE IMPACT ON BOILER OPERATION AND EMISSIONS.

- TDF INCREASES STEAM OUTPUT OF BOILER

- CIRCULATING FLUIDIZED BED BOILERS CAN BURN LARGE AMOUNTS OF TDF WITH RDF.

ECONOMIC CONSIDERATIONS

- ENERGY RECOVERY OF VARIOUS FUELS
- ESTIMATED VALUE OF STEAM FROM TDF
- ACQUISITION COST OF TIRES
- TYPE OF BOILER AND POLLUTION CONTROLS REQUIRED
- COST OF SHREDDING TIRES

ENERGY RECOVERY OF VARIOUS FUELS

APPROXIMATE HEAT VALUE AND STEAM OUTPUT

	BTU/LB.	LBS. STEAM/ TON FUEL
COMBUSTION OF TIRES	15,000	22,000
OIL	18,500	27,000
PLASTIC	15,000	22,000
PYROLYSIS OF TIRES (FUEL PRODUCTS ONLY)	11,000 - 14,000	16,000 - 21,000
COAL	11,000 - 13,000	16,000 - 21,000
REFUSE DERIVED FUEL (RDF)	5,500 - 6,500	7,500 - 8,900

ESTIMATED VALUE OF STEAM FROM TIRES

PRICE OF STEAM, $/M LB.	6	8	10
VALUE OF STEAM FROM 1 TON TIRES, $	132	176	220
VALUE OF STEAM FROM 100 TONS TIRES, $	13,200	17,600	22,000
VALUE OF STEAM BASIS 100 TONS TIRES/DAY, FIVE DAYS/WEEK, 50 WEEKS/YEAR	$ 3,300,000	4,400,000	5,500,000

ACQUISITION COST OF SCRAP TIRES

- VARIES WITH LOCATION AND QUANTITY OF TIRES REQUIRED
- ASSUME APPROXIMATELY 1 SCRAP TIRE PER CAPITA PER YEAR
- ACQUISITION COST FOR TIRES CAN BE ZERO OR LESS. A DISPOSAL FEE OF $20 TO $60/TON CAN BE CHARGED, BUT MAY BE OFFSET BY HAULING COSTS IF HAULING IS REQUIRED.
- HAUL DISTANCE IS IMPORTANT. HAULING 200 TO 300 MILES MAY RESULT IN A $10 TO $20/TON ACQUISITION COST.

TYPES OF BOILERS

- TRAVELLING GRATE DEDICATED RDF BOILER
- CIRCULATING FLUIDIZED BED BOILER
- PYROLYSIS SYSTEM - PRODUCES
  - GAS
  - OIL
  - COMBUSTIBLE CHAR

Travelling Gate for burning RDF or TDF

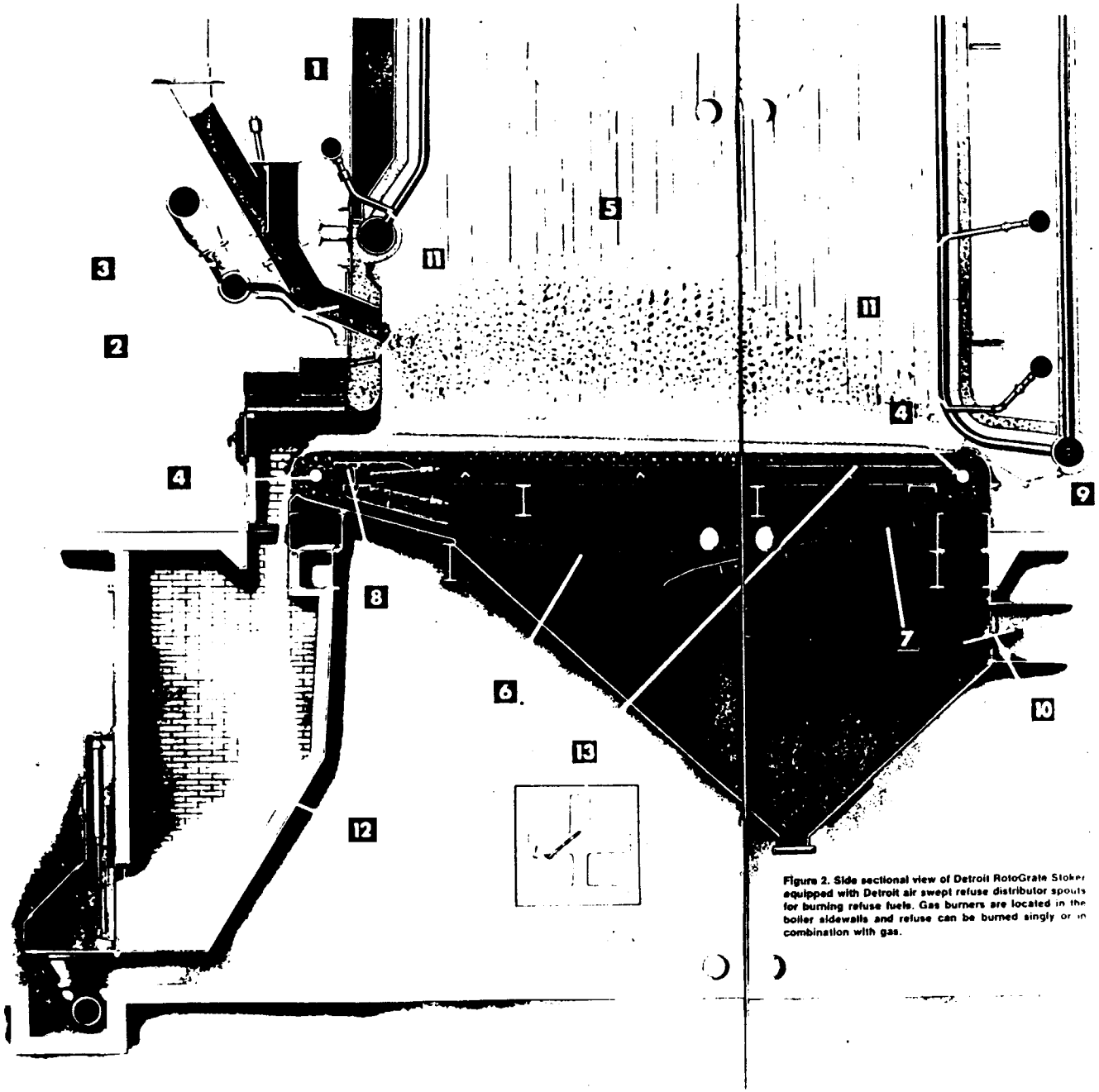


Figure 2. Side sectional view of Detroit RotoGrate Stoker equipped with Detroit air swept refuse distributor spouts for burning refuse fuels. Gas burners are located in the boiler sidewalls and refuse can be burned singly or in combination with gas.

Important features

1. **Balanced Damper Assembly** The inlet of each air swept refuse distributor spout is equipped with a balanced damper assembly which contains a counterweighted damper whose purpose is (a) to reduce the velocity of refuse before entering the air swept spout, (b) distribute the flow of refuse across the width of each spout, (c) prevent fire flashback up through the spout in case of furnace pulsations and (d) prevent infiltration of air into the furnace when no refuse is being burned.

2. **Detroit Air Swept Refuse Fuel Distributor Spouts** Are available in various widths to permit the best combination of feeder size and number of feeders for uniform fuel distribution in any furnace width. They utilize a curtain of air which sweeps the floor of the spouts and floats fine and light density refuse fuel well into the furnace.

3. **Motorized Rotary Air Dampers** Control the air to each air swept refuse fuel distributor spout by alternately increasing and decreasing both quantity and pressure of the air in several cycles per minute assuring even fuel distribution from front to rear of furnace.

4. **Front and Rear Grate Shafts** Carry the grate chains on hardened sprockets and a bearing is located at each side of each row of grates.

5. **Grates** Are specially designed for spreader stoker firing. Unique hinged grate bar design permits the individual grate bars to open at the lower portion of the catenary facilitating air admission to the fuel bed and to discharge any siftings that may accumulate on the lower strand.

6. **Catenary Design** provides automatic take-up or tensioning of grate chains to prevent jamming.

7. **Rear Slide Rail** Is adjustable so that effective catenary is maintained.

8. **Automatic Under Grate Air Seal** Are ruggedly constructed and self-adjusting. A Detroit RotoGrate exclusive.

9. **Air Seals** Are provided at rear and each side of the stoker preventing air infiltration.

10. **Blast Gate** Positioned to assure uniform air pressure distribution in the plenum.

11. **High Pressure Over Fire Air Jets** Strategically located, provide turbulence and thorough mixing of the volatile matter and air to assure complete combustion.

12. **Ash Storage Hopper** Ash is automatically discharged to the ash storage hopper and periodically removed to the ash removal system.

13. **Thermocouple Assemblies** Are attached to stoker top support rails to accurately measure temperature of grate castings. If grate temperature exceeds safe limits, operating personnel can act promptly to make necessary operational changes to keep grate temperature within safe limits, assuring long grate life.

Fuel Flexibility

Götaverken CFBs burn a wide variety of fuels including coals ranging from anthracite to lignite, biomass, sludge, peat, bagasse and RDF (Refuse Derived Fuel).

Fuels are burned alone or in combination. This permits flexibility in selecting the most economical fuel source without physical changes to the unit.

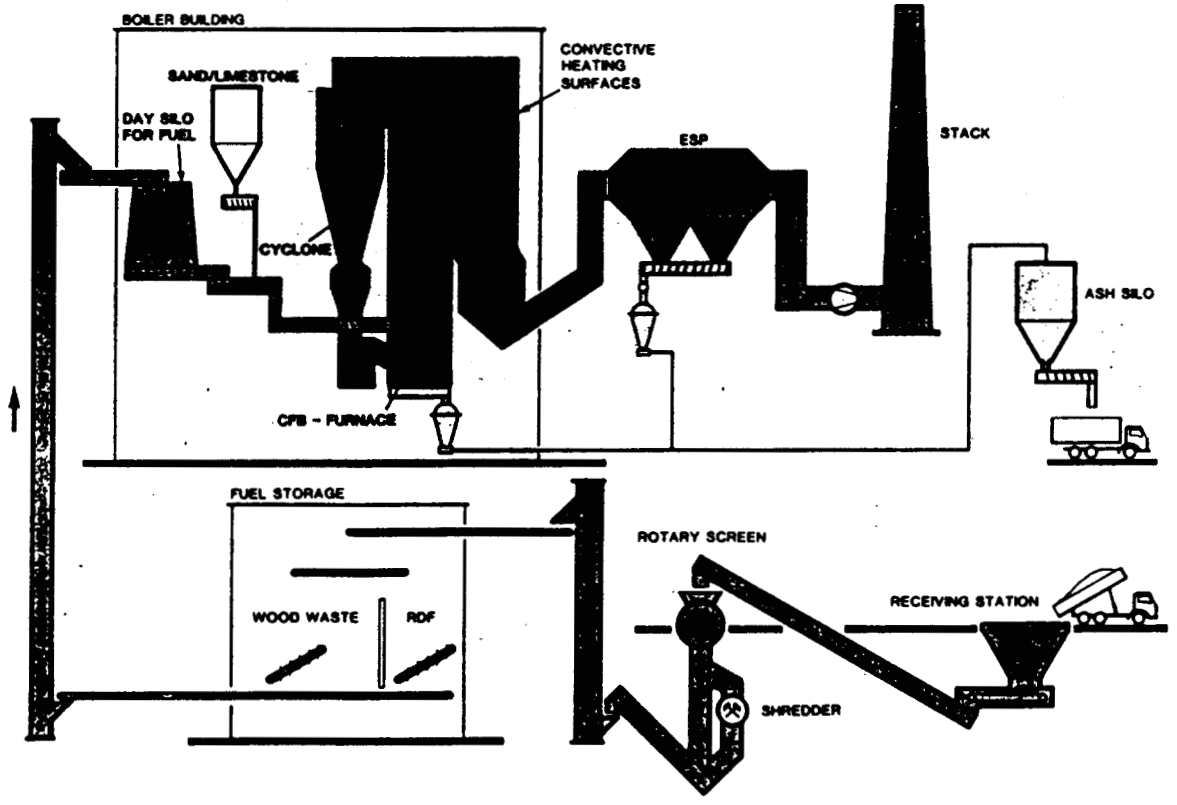
High sulfur coals are burned meeting code compliance without the addition of an SO_2 scrubber. Desulfurization is accomplished by feeding limestone with the fuel.

Low ash fusion temperature coals and peat are burned without slagging or clinkering because the CFB operates at temperatures well below the ash melting point.

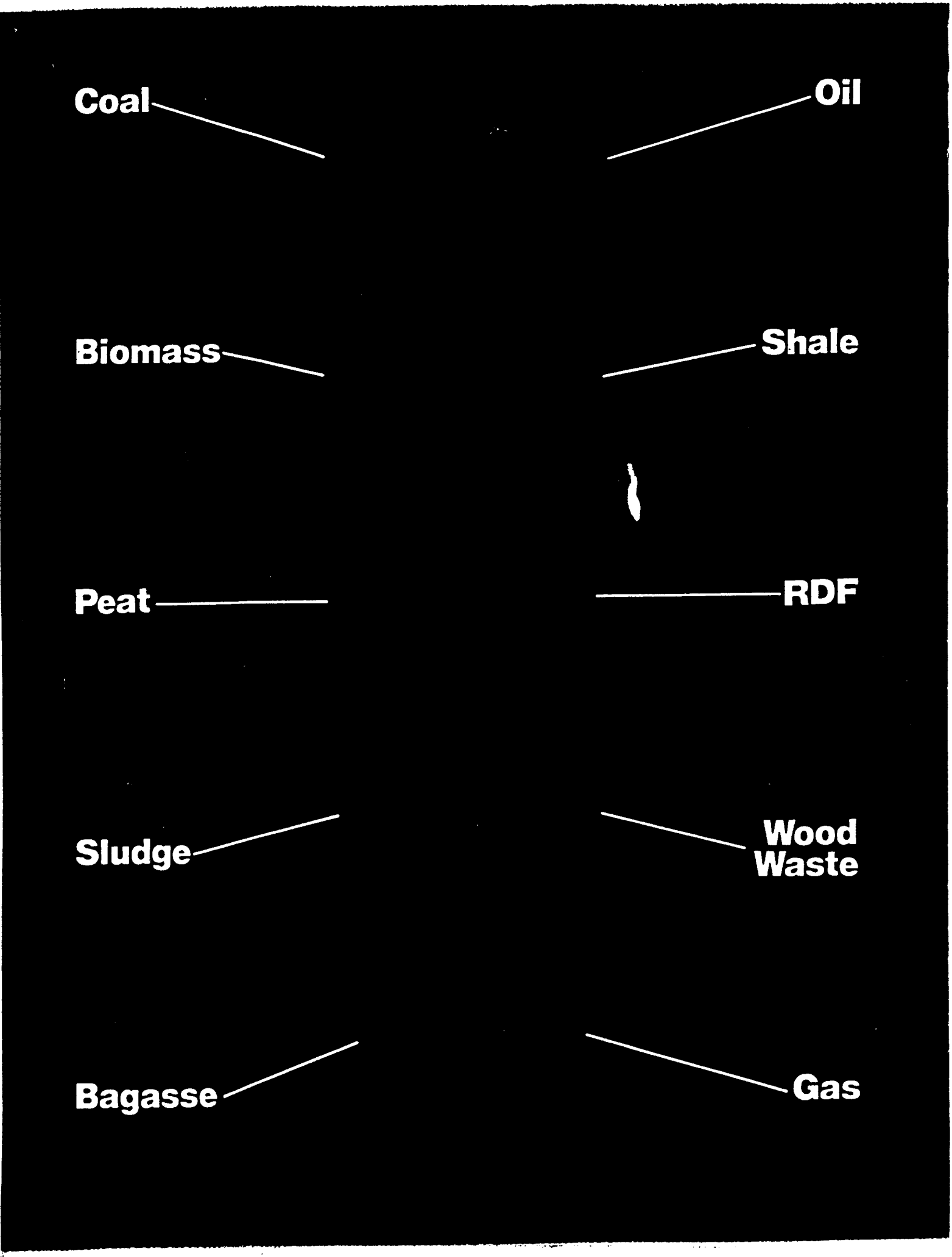
High ash fuels are ideal for CFBs since the inherent ash forms the inert bed material.

RDF is burned successfully because good mixing prevents formation of stratified pockets of incomplete combustion.

High moisture fuels are burned without difficulty since there is a large reservoir of heat to dry the wet incoming fuel.



CFB Turnkey Boiler Plant Burning RDF/Wood Waste/Peat, Sundsvall, Sweden


Coal
Oil
Biomass
Shale
Peat
RDF
Sludge
Wood
Waste
Bagasse
Gas

TIRE SHREDDERS

- SLOW SPEED SHEAR MILL
- BOILERS REQUIRE APPROXIMATELY 2 INCH x 2 INCH SIZE
- ESTIMATED COST OF SHREDDING TO 2 INCH x 2 INCH SIZE:
  $15 TO $20/TON

Tire Shredding Systems with Storage Four Ashes, England

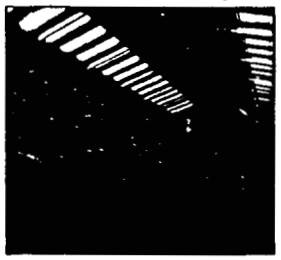
AN ABC OF TYRE TRANSFORMATION.

A FEED STORAGE AND LOADING.

The tyres (up to 1.75 metres diameter) are fed via front-end loader and fixed crane. The double rotor knife mill shreds tyres and associated matter. The product is sized to give a nominal 8" maximum in a rotary screen.

Output is then weighed and conveyed to the top of the reactor in 240kg batches and fed into the reactor lock hoppers. (Oversize shred is re-cycled back to the mill for further reduction.)

A buffer stock equivalent to four days throughput alleviates any maintenance difficulties.



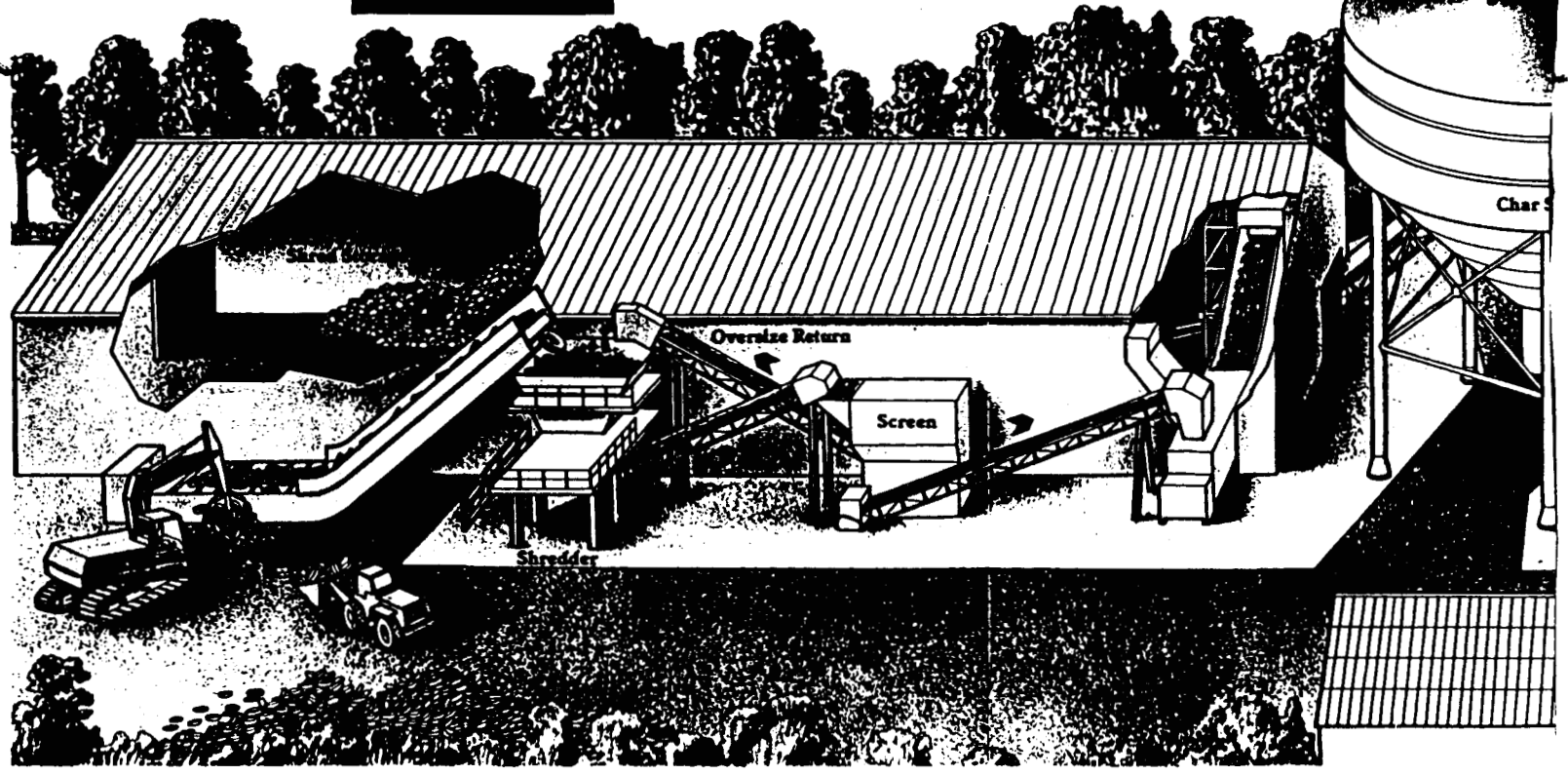
B REACTOR, OIL AND GAS PROCESS LOOPS.

The shredded tyres enter the reactor via a purged triple valve, double chamber sealing system. Hot, oxygen-free gases pass through the bed of tyres in a counter-current fashion causing pyrolysis to occur. The hot gases, now supplemented by pyrolysis product oil in the vapour phase, leave the reactor through a short overhead line, and enter the line quench where they meet a spray of cold oil. The vapourised product oil condenses, and all oil is collected in the base of the primary quench tower. After initial filtering, the flash point is adjusted before further filtering, cooling and pumping to storage.

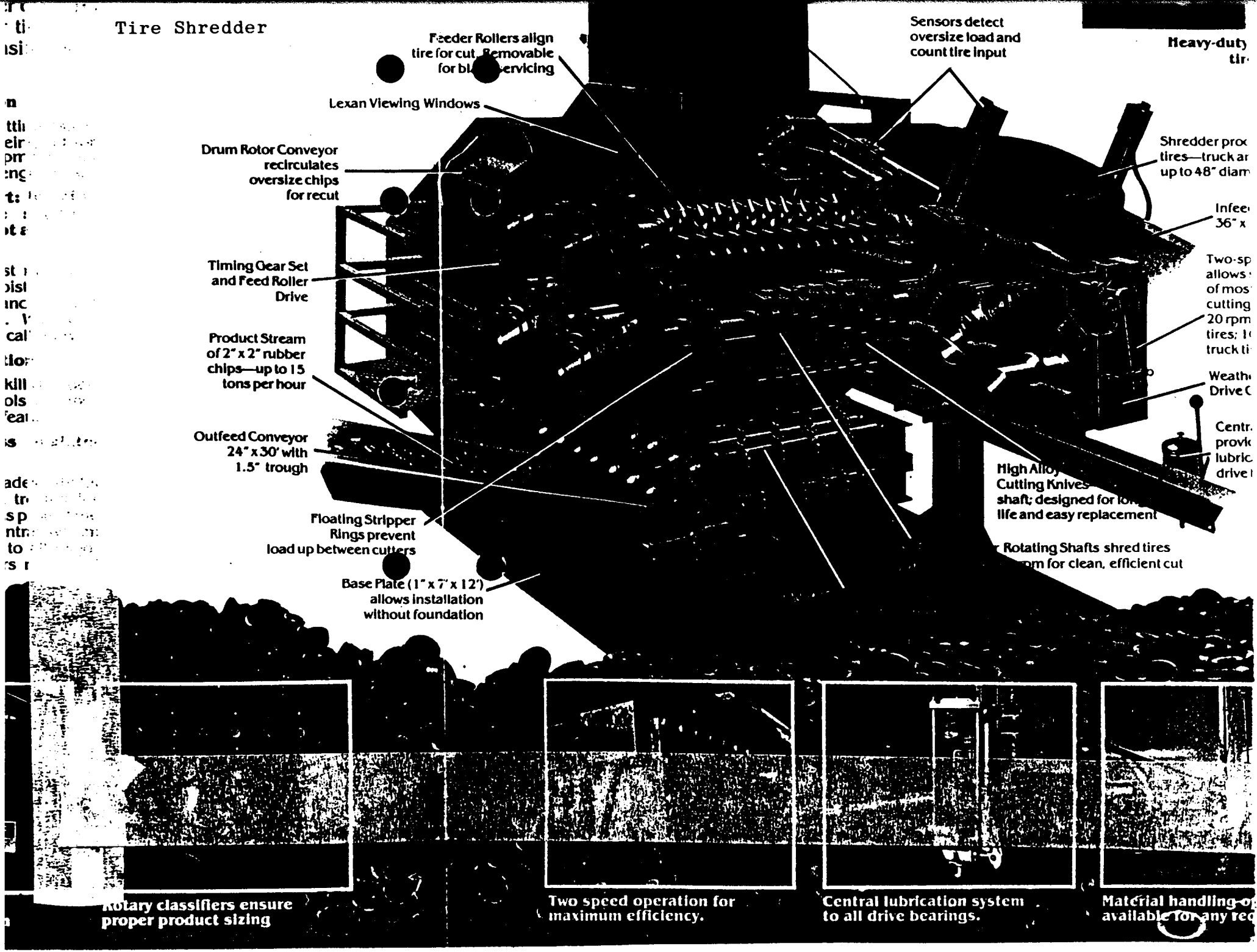
Gases come overhead from the quench tower at approximately 90 degrees C. They contain light ends and water in the vapour phase which are condensed in the overhead condenser, and collect in the decanter where lights and water are separated.

Clean gases from the decanter pass through a knock-out drum into the recycle blower. They are then either used for steam raising or as the priority fuel for the fired heater, or they pass through the tubes of the heater and back into the reactor.

Solids (friable carbonaceous char and lengths of steel wire) are removed from the reactor bed by large inclined screws. They then fall by gravity into hollow flight screws to be cooled to below the ignition point of the char. A final screw conveyor feeds them into a purged triple valve, double chamber lock hopper system, from which they leave the reactor atmosphere.



Tire Shredder



Rotary classifiers ensure proper product sizing

Two speed operation for maximum efficiency.

Central lubrication system to all drive bearings.

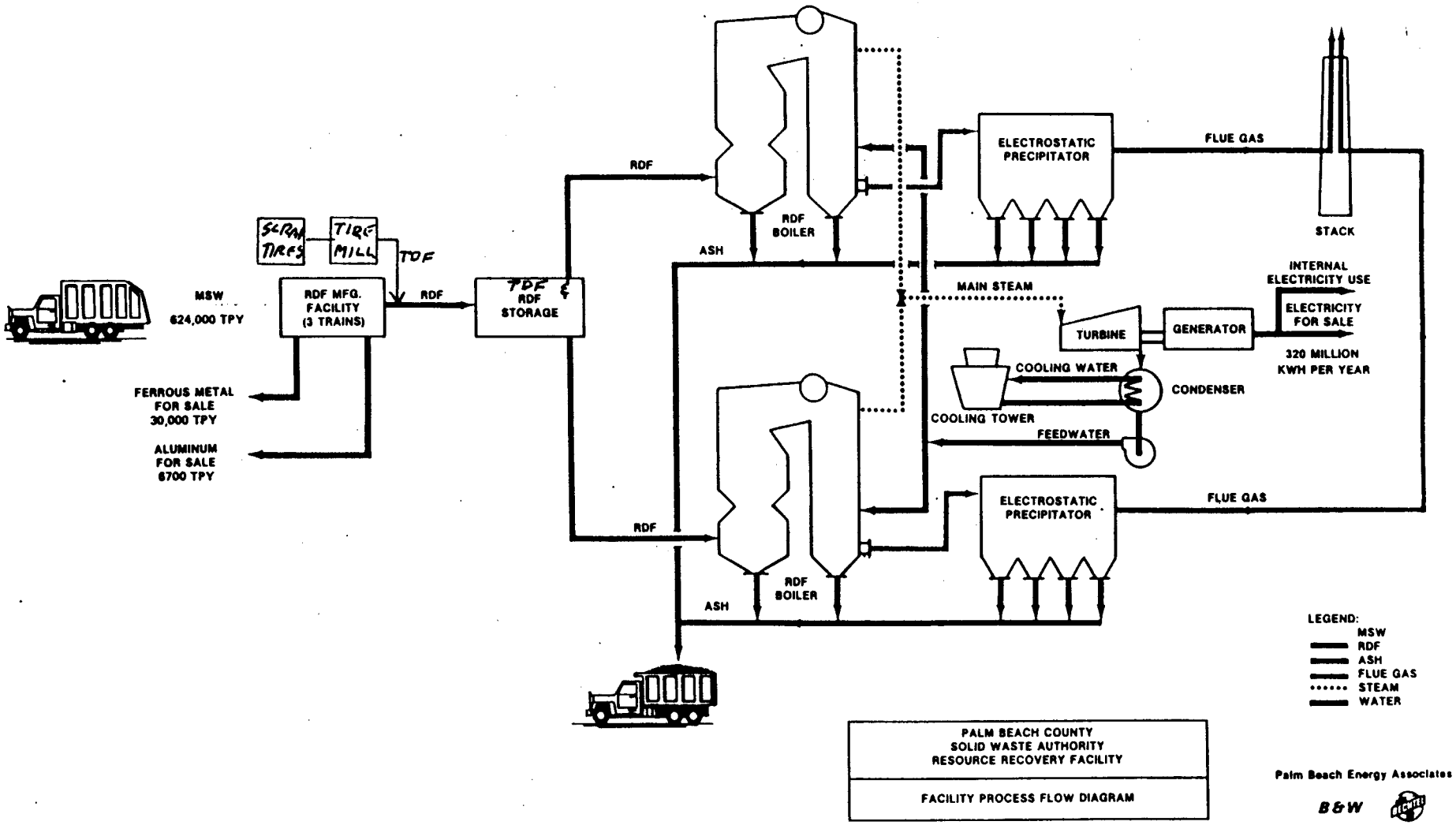
Material handling o available for any req

TYPICAL

TIRE-DERIVED FUEL/RESOURCE RECOVERY SYSTEMS

	TONS PER DAY	
	MSW	TIRES
• AKRON, OHIO	800	11 (80 MAX)
• PALM BEACH COUNTY, FLORIDA	2,000	20-40
• COLLIER COUNTY, FLORIDA	850	250 MAX
• ERIE, PA.	850	250 MAX

Process Flow Sheet for Burning RDF & TDF



ENVIRONMENTAL ASPECTS

- TIRES HAVE APPROXIMATELY 1% SULPHUR (LESS THAN MOST COALS ON A HEAT BASIS).
- SULPHUR EMISSIONS NEGLIGIBLE IF TDF IS ONLY 1 TO 2% OF FUEL
- SULPHUR EMISSIONS CAN BE REDUCED TO EPA STANDARDS BY USE OF
  - DRY SCRUBBERS OR
  - CIRCULATING FLUIDIZED BED, OR
  - BOTH

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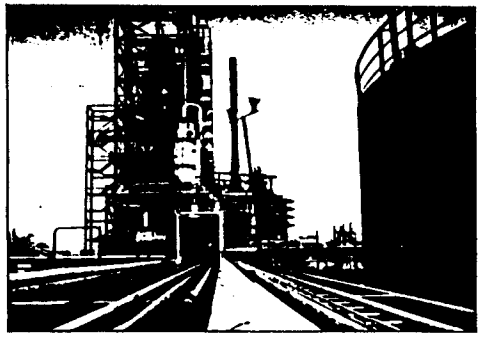

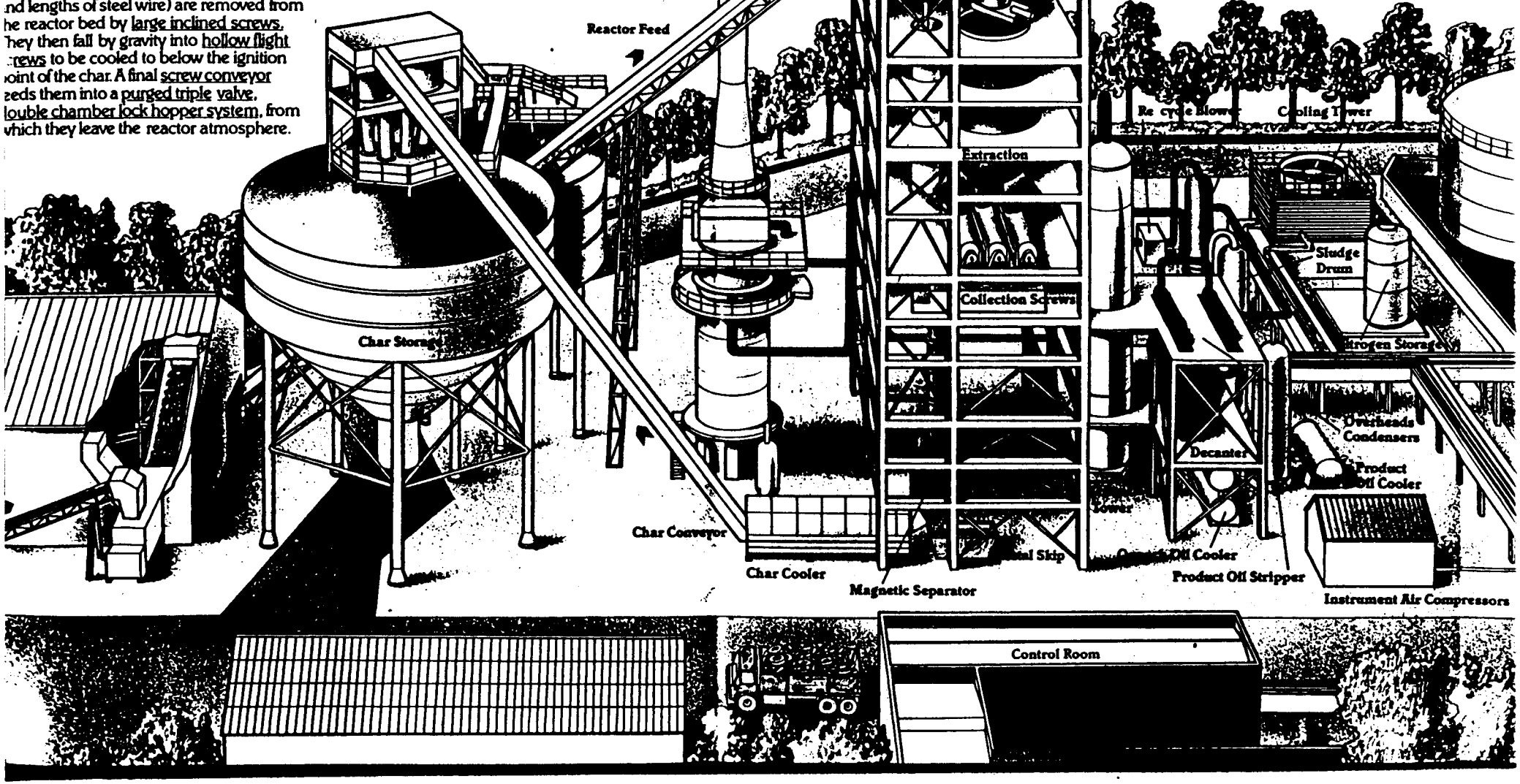

SUMMARY

- ONE SYSTEM CAN DISPOSE OF BOTH MSW AND TIRES
- TDF PAYS FOR ITSELF IN STEAM GENERATED
- TDF BURNS WELL IN STATE-OF-THE-ART BOILERS
- SULPHUR EMISSIONS ARE INSIGNIFICANT AT LOW PERCENTAGES OF TDF AND CAN BE READILY CONTROLLED AT HIGHER PERCENTAGES.