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Training of Trainers Programme

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GreenVETAfrica mission is to offer an innovative capacity building programme on Green Waste Management in Nigeria and Ghana

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UNIT FOUR

MECHANICAL DRIVE SYSTEM IN WASTE MANAGEMENT

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Objective

- Demonstrate proficiency in the fundamentals of mechanical drive systems and their relevance to waste management processes.
- Comprehend the mechanical components, including gears, belts, and pulleys, frequently utilized in waste management machinery.

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Introduction to Mechanical Drive Systems in Waste Management

- Mechanical drive systems play a pivotal role in modern waste management, offering efficiency, reliability, and sustainability in the disposal and recycling of waste materials.
- These systems encompass a wide range of mechanical components and technologies.
- They are designed to facilitate the collection, transportation, processing, and disposal of waste in an organized and environmentally responsible manner.

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Overview of key components in Mechanical Drive Systems:

- Mechanical drive components are fundamental elements in waste management machinery that enable efficient movement, processing, and transportation of waste materials, contributing to the effectiveness and reliability of waste management.

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Key components of Mechanical Drive Systems

- ❑ Gears
- ❑ Belts
- ❑ Pulleys
- ❑ Sprockets and Chains
- ❑ Bearings
- ❑ Shafts
- ❑ Seals
- ❑ Couplings

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GEARS

- These are mechanical components with teeth that mesh together, transmitting rotary motion and torque from one part of a machine to another
- Form of wheel with teeth machined around the outer edge, which allows it to engage with another similar, wheel or rack.
- Can be enclosed in a casing which contains a lubricant.

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TYPES OF GEARS

- Spur Gear
- Herring-Bone Gears
- Bevel Gears
- Spiral Gears
- Worm Gears
- Rack And Pinion
- Planetary or Internal Gears
- Hypoid Gears

SPUR

HERRING-BONE

BEVEL

SPIRAL

WORM

RACK & PINION

PLANETARY

HYPOID

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APPLICATION OF GEARS IN WASTE MANAGEMENT

- Conveyor Systems: Gears are used in conveyor systems to drive rollers or drums, moving waste materials along a designated path for sorting or processing.

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APPLICATION OF GEARS IN WASTE MANAGEMENT

- Compactors: Gears are integral to compactors, amplifying the force applied to compress waste, reducing its volume for efficient storage and transportation.

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APPLICATION OF GEARS IN WASTE MANAGEMENT

- Shredders: Gears are used in shredders for power transmission, speed control, torque multiplication, reversing capability, and safety. They enable the shredder to effectively reduce waste materials into smaller, more manageable pieces, making waste disposal and recycling processes more efficient and environmentally friendly.

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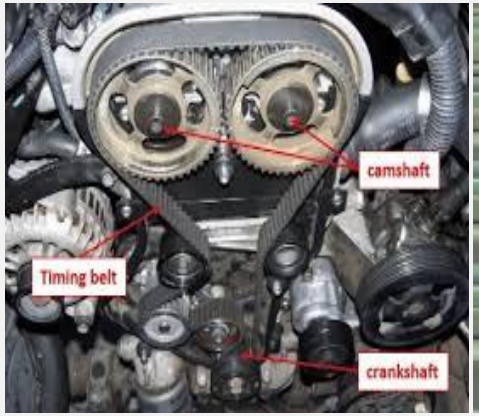
TYPES OF BELTS

- Flat Belts
- V-Belts
- Timing Belts
- Round Belts
- Conveyor Belts
- Modular Belts
- Chain Belts
- Elevating Belts

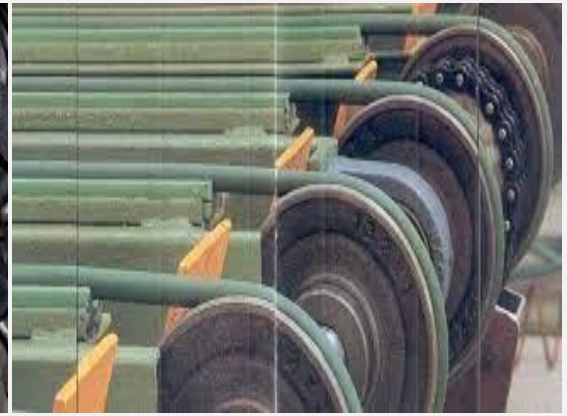
FLAT

V-BELT

TIMING BELT

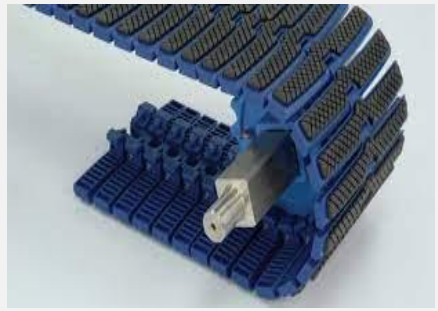


ROUND



CONVEYOR

MODULAR



CHAIN BELTS

ELEVATING

TYPES OF BELTS USED IN WASTE MANAGEMENT

- Belts are commonly used to handle and transport various types of waste materials efficiently within waste processing facilities. They are designed to handle challenges posed by the waste materials they handle, including abrasion, impact, and contamination. Here are some common belts used in waste management:

- Rubber Conveyor Belts; common choice for waste management applications. They are durable and can handle a wide range of waste materials.
- Chain Belts; made of metal links, are well-suited for handling heavy and abrasive waste materials, including scrap metal and construction debris. They are often used in recycling facilities and waste sorting systems.

TYPES OF BELTS USED IN WASTE MANAGEMENT

- Belt Filter Presses: they use special porous belts to dewater and separate liquids from sludge or organic waste materials. These belts are designed to allow the efficient drainage of liquids, making them useful in dewatering process.
- Elevating Belts: are designed to move waste materials vertically, such as when transferring waste from one conveyor to another at different elevations within a facility.

- NOTE: The choice of conveyor belt type in waste management depends on factors like the type and size of waste materials being handled, the facility's layout, the required capacity, and the specific need of the waste management process.

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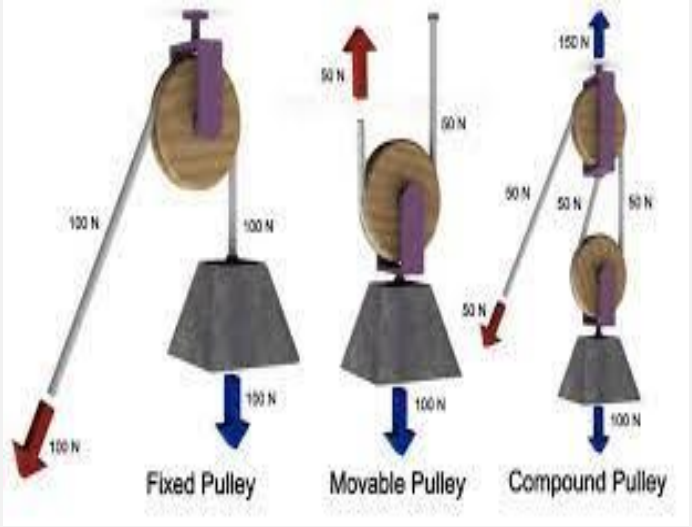
PULLEYS

Pulleys are wheels with a grooved rim, designed to guide and support belts or cables while transmitting motion and force.

- ❑ Fixed Pulley
- ❑ Moveable Pulley
- ❑ Compound Pulley
- ❑ Block and Tackle
- ❑ Single-groove and Multi-Groove Pulleys
- ❑ Cone Pulley
- ❑ Timing Pulley
- ❑ Idler Pulley



Cone

Block and Tackle

Idler

Timing

Single & Multi-Groove

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Application of Pulley in Waste Management

- Conveyor Systems: Pulleys are an integral part of conveyor systems used in waste sorting facilities and recycling plants. They help transport waste materials along a designated path, making it easier to sort, process, and move materials within the facility.
- Compactors: Waste compactors use pulleys to drive mechanisms that compress waste materials, reducing their volume for efficient storage and transportation.
- Lift Systems: In waste collection vehicles, pulleys are often used to lift and empty waste containers or bins into the vehicle's storage compartment.
- Waste Shredders: In waste shredding equipment, pulleys help drive rotating blades or cutting mechanisms that break down waste materials into smaller, more manageable pieces for further processing.

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Chains & Sprockets

- Sprockets are toothed wheels used in conjunction with chains to transmit rotary motion and power.
- Chain and sprockets provide a positive form of drive which does not slip.
- Relies on friction, links engage with specially formed teeth on the sprocket.

Chains & Sprockets in Waste Management

- Conveyor Systems: Chain and sprocket assemblies are used to drive conveyor belts in waste sorting facilities.
- Waste Shredders: In waste shredding equipment, chains and sprockets drive the rotating blades or cutting mechanisms into smaller, more manageable pieces for further processing or disposal.
- Transfer Stations: At transfer stations where waste materials are loaded onto larger vehicles, chains and sprockets power the equipment responsible for conveying waste into waiting trucks or railcars.
- Waste-to-Energy Facilities: In waste-to-energy plants, chains and sprockets are used to move waste materials into incinerators or gasification units, where they are converted into energy.

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Bearings

- A mechanical drive component that supports a rotating shaft or spindle and guides any component that slides over another.
- A bearing is designed to allow relative movement between two separate components to occur with the least possible frictional resistance.
- Bearings allow one part to rotate or move relative to another while minimizing friction, wear, and heat generation.
- They typically consist of a stationary outer ring, a rotating inner ring, and rolling elements (balls, rollers or needles) that separate the two rings and enable smooth motion.

Categories of Bearings

- Plain Bearing: Also known as bushings or sleeve bearings, plain bearings do not have rolling elements. Instead they consist of a plain surface, such as a cylinder or a disk, in direct contact with the shaft. They are often used in applications where low-speed, oscillating, or intermittent motion is required.
- Rolling Element Bearing: Also known as an anti-friction bearing, is a type of bearing that use rolling elements to separate the stationary inner ring (also known as the inner race) and the rotating outer ring (also known as the outer race). These rolling elements, typically in the form of balls or cylindrical rollers, reduce friction and allow smooth, controlled movement between the two rings.

PLAIN BEARING

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Types of Bearings

- BALL BEARINGS
- ROLLER BEARINGS
- SELF-ALIGNING BEARINGS
- ANGULAR CONTACT BEARINGS
- THRUST BEARINGS
- CYLINDRICAL ROLLER BEARINGS
- TAPERED ROLLER BEARINGS
- SPHERICAL ROLLER BEARINGS

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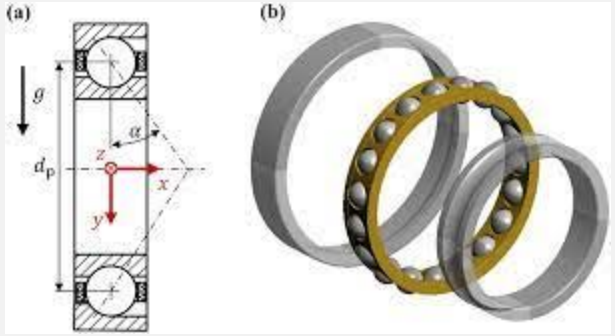
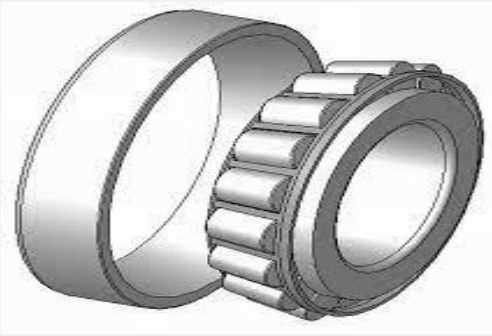
Types of Bearings

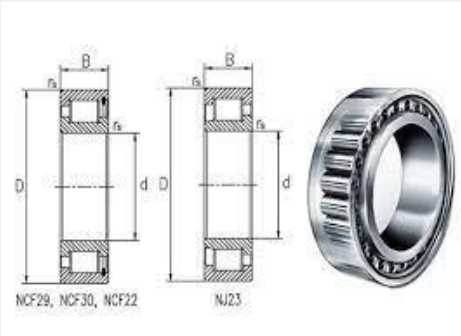
ANGULAR CONTACT



TAPERED ROLLER



ROLLER



CYLINDRICAL ROLLER

BALL

SELF-ALIGNING

SPHERICAL ROLLER

THRUST

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Application of Bearings in Waste Management

- Conveyor Systems: Bearings are used in conveyor rollers and pulleys, reducing friction as waste materials are transported along conveyor belts in sorting facilities and recycling plants. They ensure smooth material movement and minimize wear on the conveyor.
- Waste Shredder: Bearings support the rotating shafts and blades in waste shredding equipment, allowing for the efficient breakdown of waste materials into smaller pieces. Bearing ensure that the blades rotate smoothly, reducing energy consumption and wear.
- Compactors: Waste Compactors use bearings in various moving parts, including the compaction mechanism and hydraulic systems. Bearings minimize friction and facilitate smooth operation of these components, extending their lifespan.

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SHAFT

- Shaft is a member usually of circular section which supports gears, sprockets, pulleys, rotors, etc. and which is subjected to torsion or axial loads, acting singly or in combination.
- Shaft is a mechanical component used in various machines and equipment to transmit rotational motion and torque from one part of the machine to another.

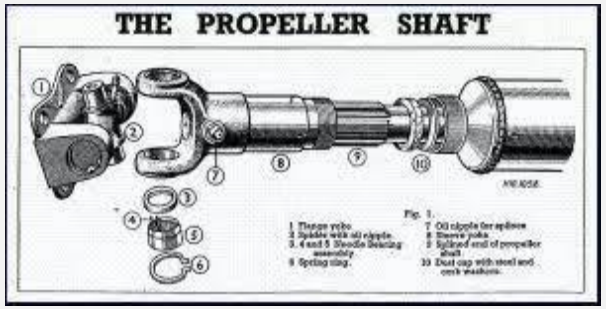
Types of Shaft

- Plain Shaft
- Drive Shaft
- Propeller Shaft
- Axle
- Crankshaft
- Camshaft
- Spindle Shaft

PLAIN

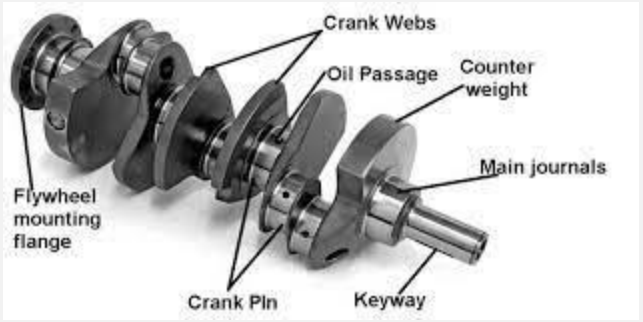
DRIVE

PROPELLER



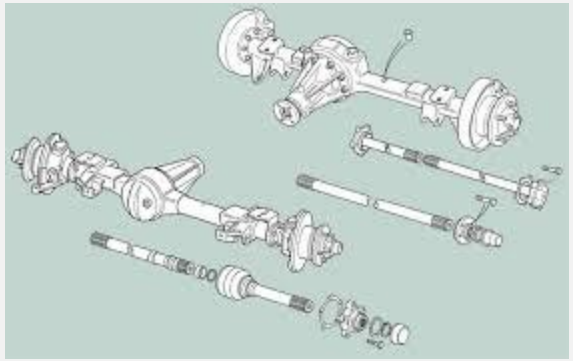
SPINDLE

CRANKSHAFT



CAMSHAFT

AXLE



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Application of Shaft in Waste management

- Power Transmission: Shafts are used to transmit power from a motor or engine to various components of waste management machinery, such as conveyor belts, shredders, crushers, and compactors. They ensure that rotational motion from the power source is efficiently delivered to these components, enabling the processing of waste materials.
- Conveyor Systems: In waste management facilities, conveyor systems are widely used for the transportation of waste materials. Shafts are an essential part of conveyor systems, connecting the drive motors to the rollers or pulleys that move the conveyor belts. They help convey waste materials from one point to another within the facility, facilitating sorting, processing, and transportation.

Application of Shaft in Waste management

- Shredding and Crushing Equipment: Waste shredders and crushers are essential for reducing the size of bulky waste materials. Shafts are used to connect the motor to the cutting or crushing mechanisms within these machines, ensuring the efficient operation of the equipment.
- Balers: In recycling facilities, balers are used to compact and package recyclable materials like cardboard, paper, and plastics. Shafts play a role in driving the hydraulic systems that compress and form these materials into compact bales

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SEALS

- Seals are used to prevent the leakage of liquids, solids and gases from items of rotating machinery and other types of industrial equipment and to stop dirt and other sources of external contamination from entering a machine or piping system.
- There are two categories:
- Dynamic Seals: O-ring Seals, Piston Seals, Mechanical Seals
- Static Seals: Gasket Seals, Flange Seals.

PISTON

O-RING

MECHANICAL

GASKET

FLANGE

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Application of Seals in Waste Management

- Gasket Seals: Gaskets are typically made of rubber or other flexible materials and are used to create a tight, leak-proof seal between two mating surfaces. In waste management: Gasket seals are used in landfill liners to prevent leachate (liquid generated by decomposing waste) from leaking into the soil and groundwater. They are also used in the flange connections of pipes, valves, and tanks in waste treatment facilities to prevent fluid or gas leaks.
- O-Ring Seals: O-rings are circular seals made of elastomeric materials like rubber or silicone. They are used in waste management equipment such as: Hydraulic systems in waste compactors and waste collection vehicles to prevent fluid leaks. Sealing joints and connections in pumps, valves, and pipes to ensure airtight or watertight seals.
- Mechanical Seals: Mechanical seals are used in pumps and agitators to prevent the leakage of liquids, especially in waste treatment processes: They help maintain a secure seal between the rotating shaft and the housing, ensuring that hazardous or corrosive liquids do not escape into the environment. In wastewater treatment plants, mechanical seals are used in pumps to prevent leakage of untreated wastewater.

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Couplings

- A coupling is a mechanical device used to connect two shafts or components together, allowing them to transmit power, motion, or torque while accommodating misalignment, shock, and vibration. Couplings are designed to ensure a secure connection while permitting some degree of flexibility or movement between the connected components.

Major types of Couplings:

- Flexible Couplings
- Rigid Couplings
- Disc Couplings
- Universal Joints
- Grid Couplings

FLEXIBLE

DISC

GRID

RIGID

UNIVERSAL

Application of Couplings in Waste Management

Couplings are vital components in various waste management machinery and equipment, helping to ensure the efficient operation of these systems:

- **Conveyor Systems**: Flexible couplings are used in conveyors to connect drive shafts and reduce shock and vibration, helping transport waste materials efficiently.
- **Shredders and Crushers**: Couplings, such as gear couplings and disc couplings, are employed in waste shredders and crushers to transmit the high torque required for size reduction.
- **Pumps**: Waste management often involves the use of pumps to move liquids or slurry. Couplings help connect the pump's motor to the impeller, enabling the transfer of fluids.
- **Sorting Systems**: Universal joints may be used in sorting systems where there is a need for flexible connections between conveyors and sorting equipment, allowing for changes in direction and alignment.

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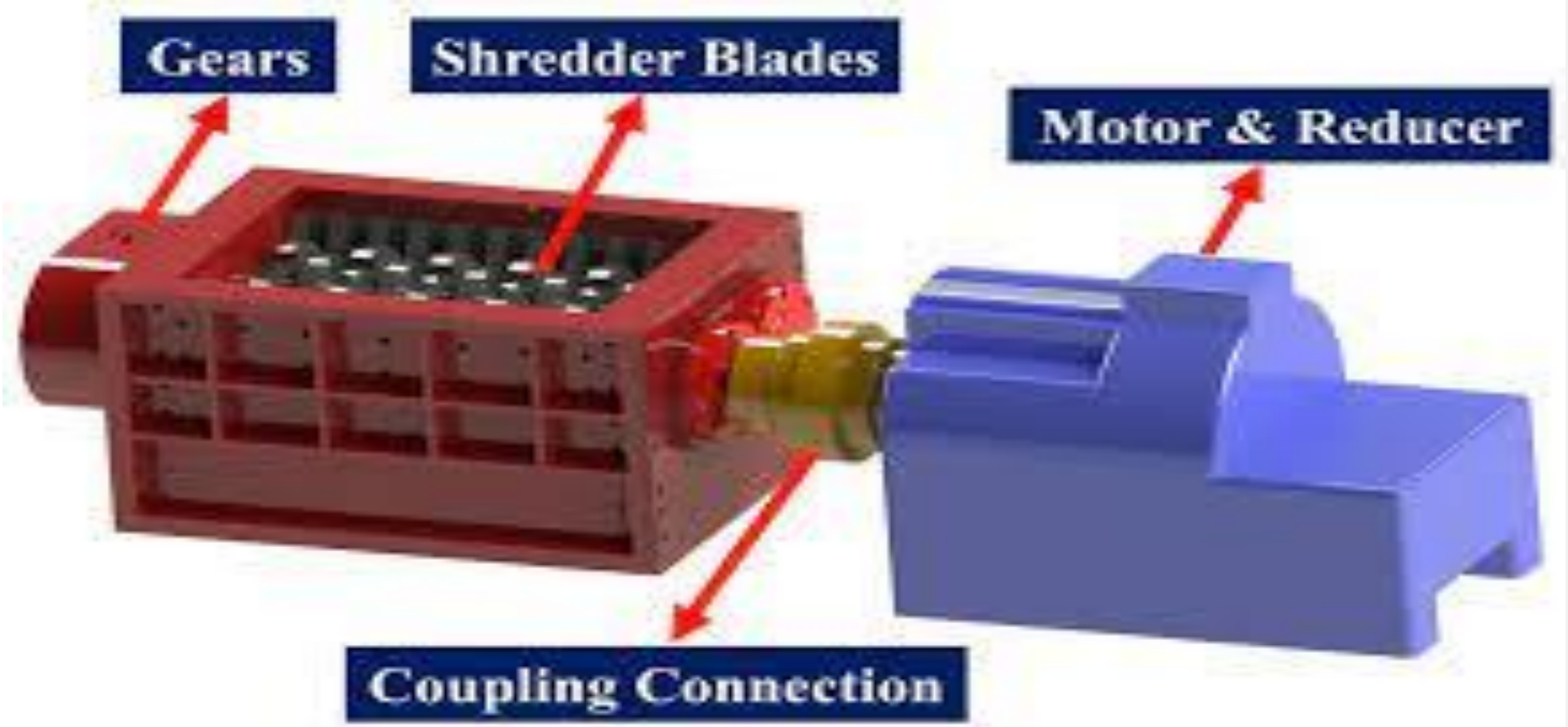
Gears
Shredder Blades
Motor & Reducer
Coupling Connection

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Front Europe to Africa

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