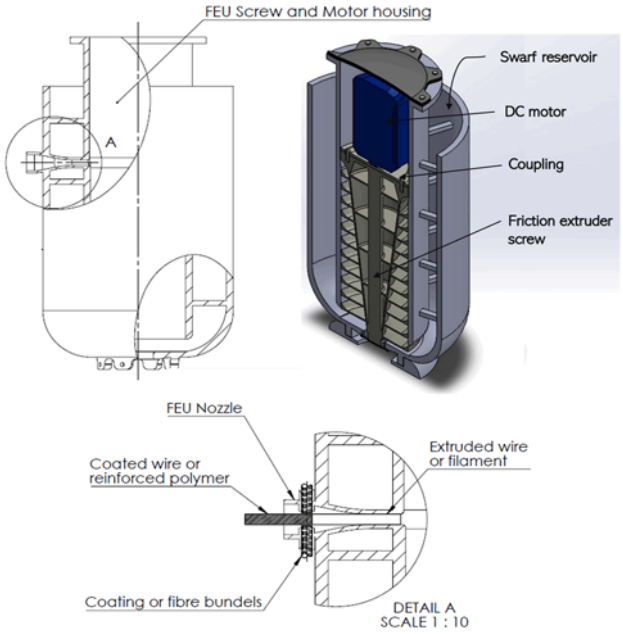
Friction Extrusion- *FricExtrusion*

Friction-based fabrication of wire and filaments for additive manufacturing

The novel FricExtrusion proposes a new method to produce wires and polymer filaments using frictional energy to convert metal swarf or polymer pellets into continuous wires or filament for additive manufacturing (AM) or 3D printing

BACKGROUND

The global machining market, valued at €353.37 billion, is projected to grow at a 6-7% CAGR (Beroe Inc.), increasing metal waste. This underscores the circular economy potential of the current invention for AM wires. Additionally, there is a niche for custom polymer filaments for 3D printing. FricExtrusion enables producing recycled and custom metal and polymer AM wires and filaments.



TECHNOLOGY

The FricExtrusion process employs mechanical deformation to generate frictional heat, inducing dynamic recrystallization in metals or softening/melting in polymers. A possible configuration (see schematic figure) features a vertically arranged extrusion setup comprising two concentric cylindrical tubes. The outer tube serves as a reservoir for metallic swarf or polymeric pellets, while the inner tube acts as the machine core. The core includes a conical friction extruder screw, driven by a motor (hydraulic, electrical, etc.), mounted atop the inner cylinder. As the thread lead increases, the conical shaft's volume decreases, causing a significant rise in pressure and friction, which in turn increases the material's temperature. This combination of pressure, friction, and heat facilitates dynamic recrystallization and viscoplastic flow in metallic wire extrusion, or gradual softening and melting in polymer filament extrusion. Finally, the viscoplastic metal or melted polymer is extruded through a nozzle at the last screw thread height, resulting in a continuous wire or filament.

ADVANTAGES

Friction-based manufacturing processes are highly energy efficient, converting up to 90% of mechanical energy to heat. Advantages of this technology also include

- Elimination of defects such as pores and solidification cracks in metallic wire, since extrusion occurs below the melting temperature.
- Utilization of swarf, chips or addition of virgin material.
- Creation of new alloy and polymer compositions, and metal or polymer matrix composites.
- Production of coextruded wires with different die geometries.
- Production of solid or hollow wires and filaments.
- Integration with post-extrusion steps such as wire/filament drawing or heat treatment to adjust properties.

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COOPERATION OPTIONS:
Licensing
Sale
Technical cooperation

DEVELOPMENT STATUS:
laboratory demonstration in progress

STATUS OF PATENTS:
Patent granted in:
France, Germany, Great Britain

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