A Linear Shredder

Creative Services has invented a new compact shredder with particular blades moving horizontally. The blades are designed to drag in material that enters the shredder from the top, and push the shredded material out at the bottom. The shredder is described in patent WO0035586.

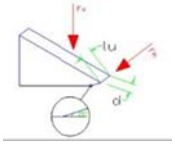
For the proper sterilization of medical waste using microwaves, the materials to be sterilized have to be shredded into pieces that are not bigger than 3 mm.

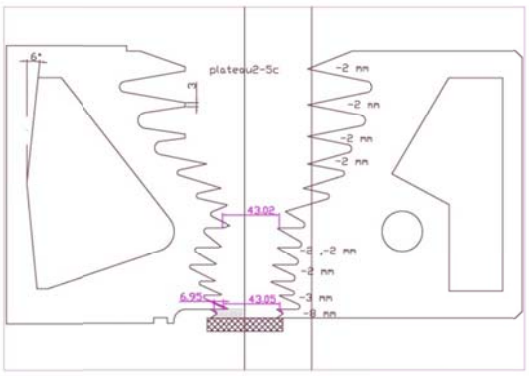
Requirements

- Take material of maximal size of 10 cm and length of 30 cm.
- The shredding result shall be of a typical size of 3 to 5 mm.
- About one kilogram of material shall be cut in one minute, at least 6 kg in 20 minutes.
- The intended material is composed of medical waste.
- The blades have to be made of anti corrosive material.
- Minimal weight for installation in mobile devices.
- The price of the shredder in large series (>2000 p.a.) shall not exceed CHF 1500.

Conventional rotary shredders are comparatively large and do not guarantee a three millimetre size result. The rotary shredding was replaced by a linear shredding concept in which two rows of blades move against each other like just like chewing with your teeth. The blades have a width according to the desired particle size, i.e. 5 mm. Two opposite blades form a pair in which one blade is fixed and the other moves forth and back. The whole shredder then holds sixty pairs, arranged one by one but every other pair inverted so that consecutive blades move against each other.

The blades were designed (AutoCAD) with teeth to be able to cut in vertical and horizontal orientation, i.e. in three dimensions. The upper teeth are larger and form a funnel. They point somewhat downwards to drag in, compress and reduce in size larger objects. The lower teeth form a channel or passage. They are designed to cut the materials further down to a few mm. Together with the teeth of the neighbouring blade, the teeth of a fixed blade form a cavity. The cavity is shaped in such a way, that material that is pushed into the cavity by the teeth of the moving blade moves upwards along a curvature which is wide enough so that the material is not compressed but pushed out this way.





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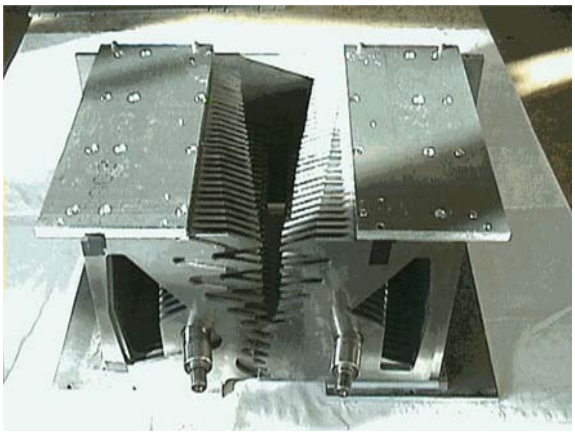
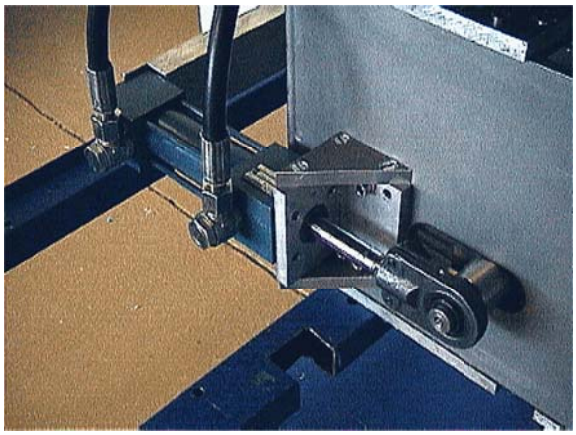
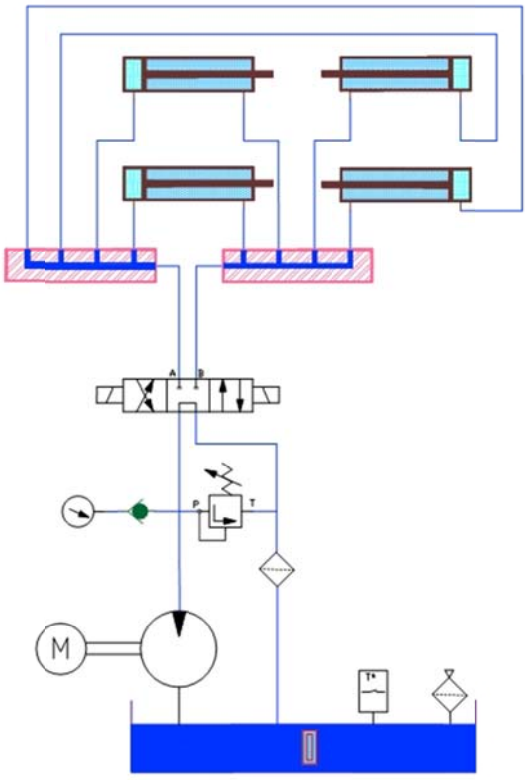
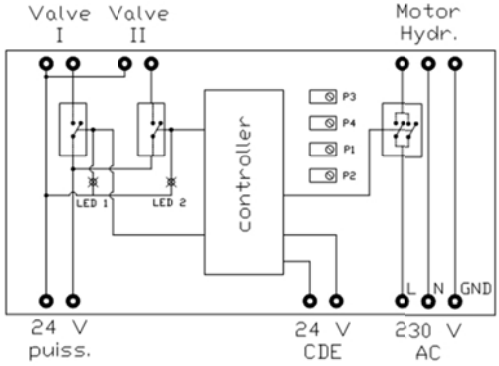
The moving blades are mounted on a horizontal axis. The slide in rails carved in a low-friction material. The axes are moved by hydraulic pistons. In later versions electric pistons have been used. The hydraulic system was chosen because the pistons are very compact.

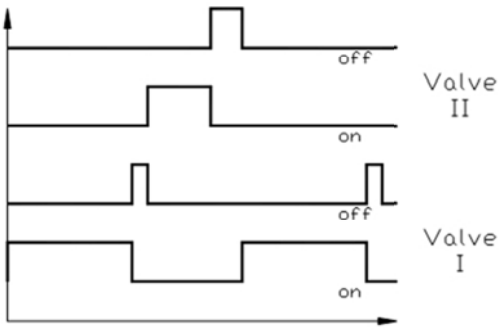




The pistons were driven by a hydraulic pump with 1.5 KW power. The lines were designed to assure equal pressure to the pistons. The electronics for the shredder are custom designed and produced accordingly. Special emphasis was put on tuning the movement of the blades for optimal result. For example it is important when and where the edges of the moving blades pass each other. This is a very critical moment. Blades which hook into each other (in a way like two cars crashing against each other) get immediately destroyed and thus ruin the shredder.

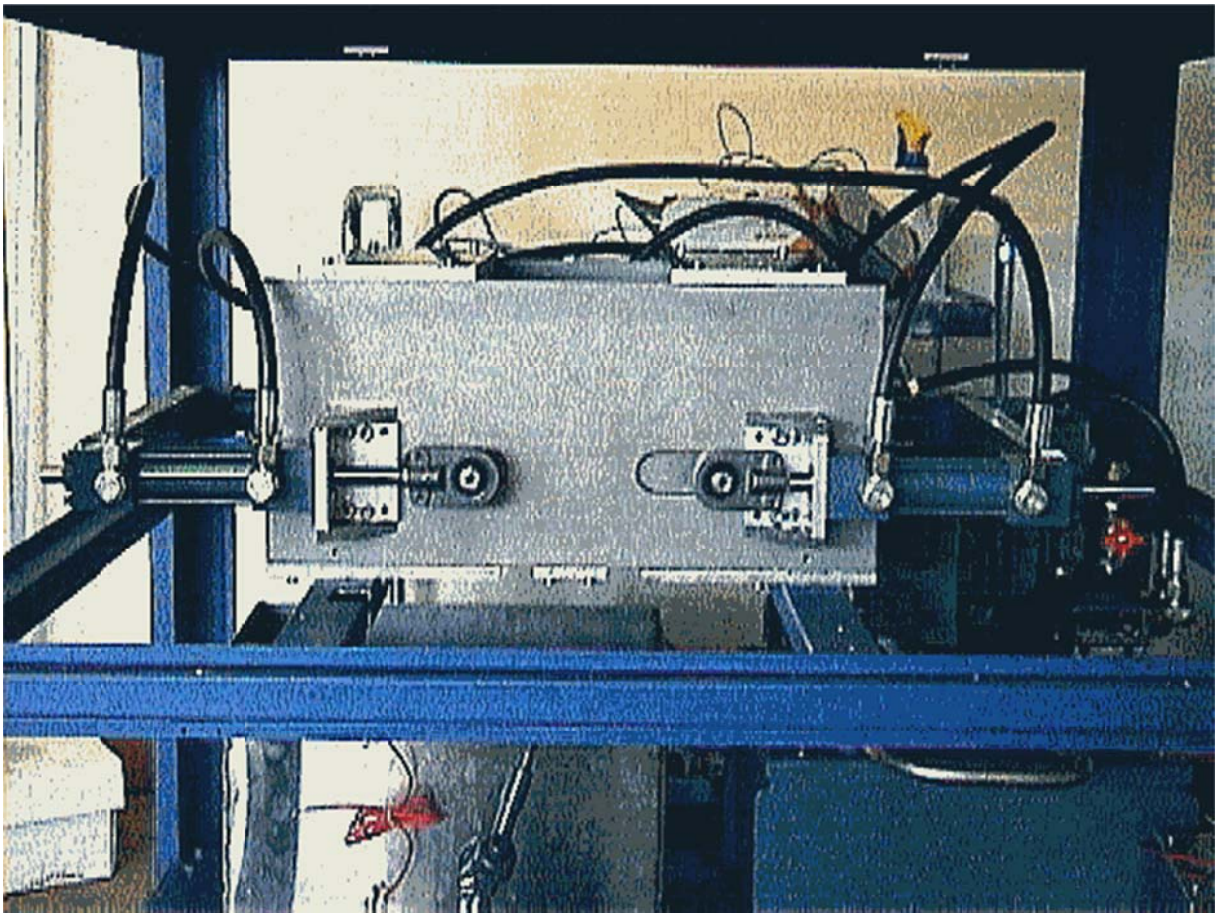






The shredder was constructed using simple stainless steel for the walls. The blades were made by laser cutting from hardened steel. For the testing, the shredder was not put into a particular housing

but mounted in an aluminium profile frame. In the course of the development five versions of the shredder were built and about variations of the blades were tried.



The results were satisfying with latest blade design. The shredded goods were very homogenous and of the required size for microwave treatment. All soft materials (plastic, wood, plaster, tissue, cotton,) were shredded easily. Also thin metal parts (like bottle caps or syringes) were shredded. The shredder had problems with piled up paper (like a book). Also, expectedly, had metal parts (like dentist drills) were a problem. All in all the overall performance was as hoped for. There is still space for improvement, in particular with the exit for the shredded particles.

The parts for the prototype, without the aluminium profile support structure, were acquired for approximately 6'800 euros. No particular efforts (e.g. buying *en gros*) were made to reduce these costs. These are in part custom made, in part off the shelf. The major cost components were the hydraulics (OTS), the carter (custom), the electronics (custom) and the blades (custom).

The manpower involved in the construction of the prototype is, of course, not a measure for industrialized production of the shredder. All tools and parts available, however, the assembly by hand will not take more than two hours.