Banknote Destruction

The primary purpose of shredding and/or granulating is to eliminate the chance of reconstitution of a whole or part of a note, and secondarily, protect the environment and to reduce the volume for disposal.

Security

As for the entire lifecycle of a banknote, security is the main concern for the user and thus the industry. It is therefore of crucial importance that the destruction of a banknote is done under, at least, the same high security guidelines.

For the safe destruction of banknotes, the following should be considered:

- Destruction within a closed environment
- 100% guarantee that all banknotes have been destroyed by the destruction system
- After the banknotes enter the destruction system, touching of the banknotes should be prevented, in order to prevent any possible fraud.
- Prevent crossing the input flow of banknotes with the output flow of the waste material or to be in the same area.

On-line and off-line banknote destruction

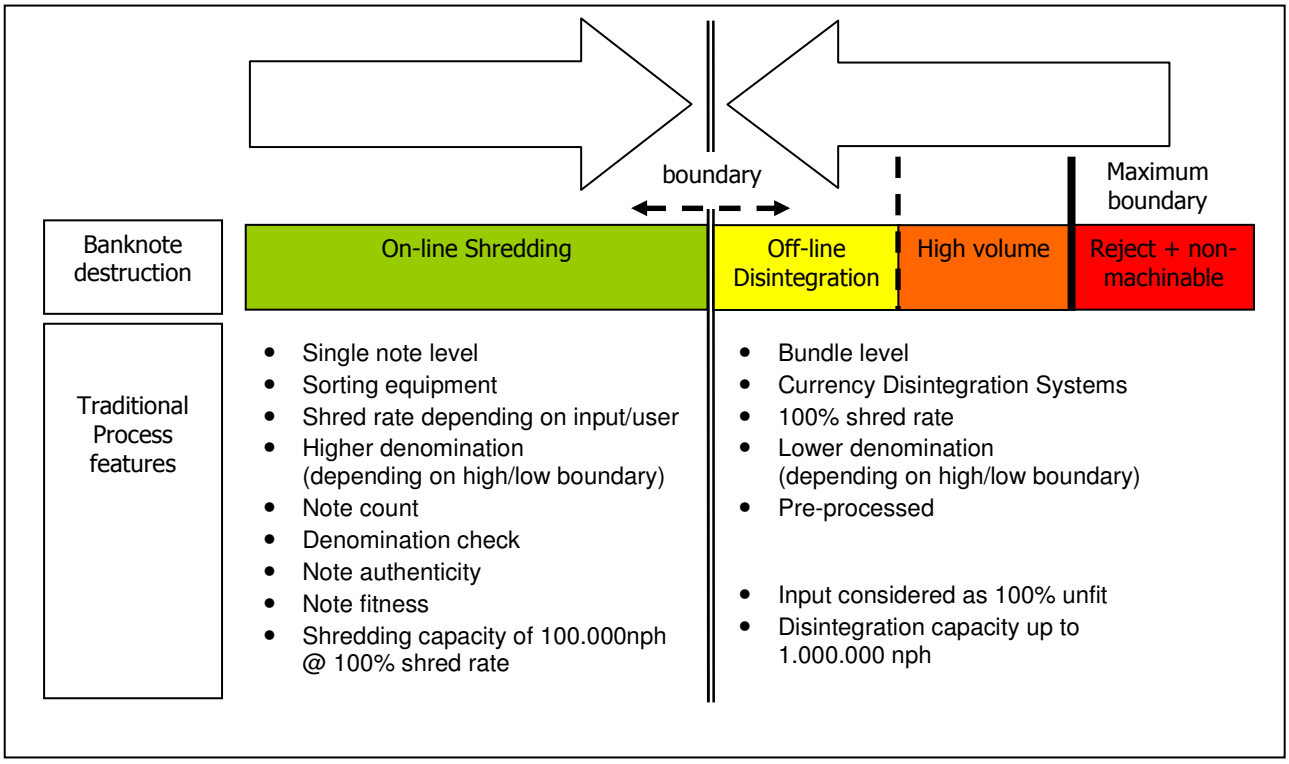
In principle there are only 2 methods for banknote destruction:

- Currency Disintegration Systems: used by Central Banks for the disintegration of bundles of up to 1.000 banknotes whether or not in packs, this is referred to as “off-line disintegration”.
- Central Banks also process banknotes on a single note basis, by means of banknote processing system (sorters). These sorters can be equipped with an integrated shredding module which destroys the genuine but unfit banknotes one by one, this is referred to as “on-line shredding”.

An off-line banknote destruction system

As where off-line disintegration systems are designed for 100% destruction (shred rate) up to 1 million+ notes per hour, the key function of the sorter is processing banknotes but at the same time these are also destroying a part of the total volume of unfit notes to be destroyed. Sorters have a destruction capacity of approx 100.000 notes per hour when set to 100% shred rate.

The above establishes a certain balance between the off-line and on-line disintegration. The boundary depends on local situation, policies and banknote quality and therefore differ for each Central Bank and even per denomination (see picture).



The Central Bank's need for authentication may move the boundary to the right resulting in an increase of on-line shredding compared to off-line disintegration (yellow area). Current developments within the off-line disintegration technology may have an opposing driver in favor of off-line disintegration.

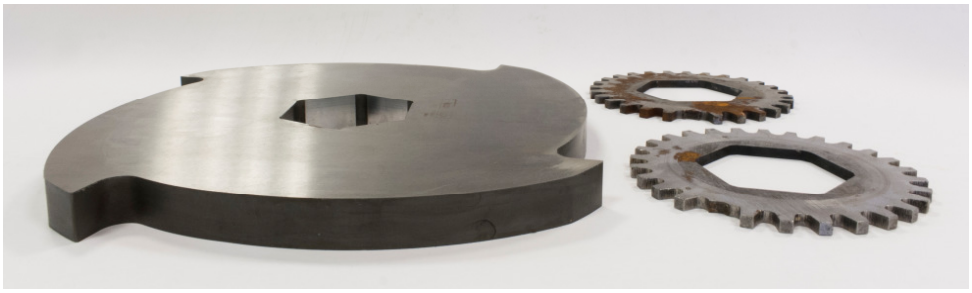
When high volumes of unfit notes are to be destroyed the capacity of the destruction process will become an increasing factor to be considered (orange area), investing multiple sorters versus a dedicated off-line disintegration system.

Finally, there will always be a share of banknotes, rejects and non-machinables, that can not be processed and thus not be on-line shredded (red area).

Destruction technology

Within the field of mechanical destruction of banknotes the following technologies are in use:

(Cross-cut) Shredding:
A shredder is a destruction system with slow contra-rotating shafts on which shredder knives are positioned. Depending on the material and desired performance and shred size, various shredder knives may be used. Shredders are often used as a first stage destruction when destroying bundles of 1,000 banknotes.

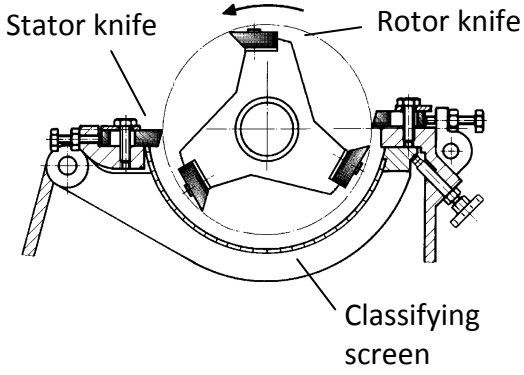


Examples of shredder knives

Granulating:
A granulator is a high-speed rotating knife mill, which is often used as second stage destruction within off-line destruction systems.

The granulator cutting technology is based on a combination of stator and rotor knives . These blades, made of special steel come with sharpening reserve, allowing re-sharpening of the knives and thus longer life-time.

A classifying screen, positioned underneath the rotating knives guarantees the pre-defined shred size.



Example of granulating knife

Shred size

Depending on off-line or on-line destruction, the shreds will differ not only in size but also in shape.

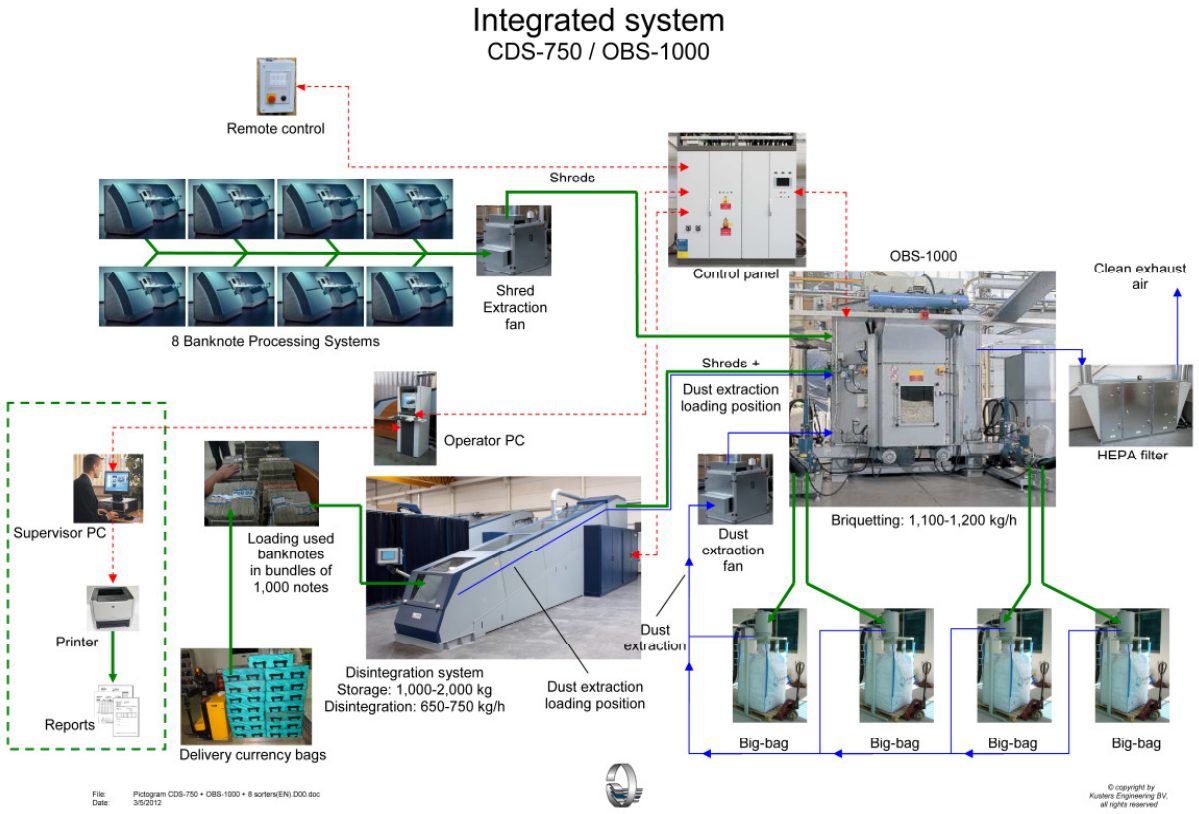
Shreds generated by on-line shredding have a typical and uniform rectangular size of approx. 2-3 x 10-15mm, while off-line shreds have an at random shape. Because of the shape the shred density of off-line shreds will be higher compared to on-line shreds.

Although there may not be an official world-wide standard for the shred size for off-line destroyed banknotes, the most common used shred size is 6 x 6 mm. When using granulating technology the shred size output can be adapted depending on the required shred size.

For shredding technology, the shred size is determined by the knives settings as where for the granulating technology it is additionally guaranteed by using a classifying screen with a specific hole size which prevent larger shreds passing through.

Shred handling

When destroying banknotes, both on- and off-line, a good reliable solution for the collection and further handling of the shreds is as important as destruction itself. Especially in case several sorters are connected to a central briquetting system for banknote shreds any hold of the briquetting system must be prevented as this would automatically result in a hold of the banknote processing operation.



In general the shreds are extracted from the destruction systems or sorters by means of a vacuum system. The configuration of such vacuum system depends strongly on the local situation and the number of sorters to be connected. Some Central Banks have up to 20 sorters connected to one central briquetting system.

Shreds can be collected in loose form but for significant volume reduction of the waste material, briquetting systems are commonly used by Central Banks.

Briquetting systems separate the shreds from the transport air and compress the shreds into manageable briquettes. The transport air is cleaned by filters before emitting to the outside. Some briquetting systems are equipped with dust extraction systems to remove any dust from various positions in the briquette production and discharge process. All this resulting in a clean and dust-free operation.

Banknote shreds and briquesttes from a mixture of Euro banknotes

Recycling of briquettes

Although the properties of the briquettes largely determine their possible further use, it must be clear that economical and environmental circumstances play a vital role in the choice of a possible applications. Some of the alternatives are:

- Landfill
- Incineration
- Paper recycling

Landfill

Dumping in landfills does not recover any energy and cannot be said to serve any useful purpose whatsoever. More than any other waste form several criteria must be borne in mind when selecting a method for disintegrating currency. These are: security, technical, economical, and environmental issues.

Incineration

Incineration widely is accepted as a solution in dealing with the increasing amounts of household and industrial waste generated in the world. It is considered to be an environmentally sound solution to the waste problem, provided that the incinerating plant is equipped with fluegas treatment systems, thus protecting the environment against the pollutants generated during combustion of solid waste.

Combustion/heating general

Banknote briquettes can be incinerated at normal temperatures (900 degrees C) and no special high temperature treatment is required. As the briquettes have excellent combustion characteristics it will be no problem to discharge them to controlled waste incineration plants. As the combustion value of briquettes is excellent (1,6 x 104 KJ/kg), it may be a favorable additive fuel to balance the poor combustion values of other kinds of waste.
The briquettes may also be used as (additional) fuel in industrial furnaces. In that case proper analyses of the briquettes to be burned will be required for the determination of the incineration products to be expected: flue gas and ash.

Fuel for the cement/ceramic industry.

All over the world cement is an essential construction element for building houses, offices, plants, roads and bridges. Cement however is not a mineral which can be readily mined, but is a reaction product of a process of burning and heating limestone with a number of additives together in a furnace. The gigantic furnaces used in this process operate at very high temperatures to provoke the requested reaction and therefore ask for large amounts of fuel.

As fuel costs represent a large cost factor in the production process of cement, it is obvious that cement producers are constantly searching for cheap additional fuels for the partial replacement of currently used fossil fuels such as oil, natural gas and brown coal. Various kinds of industrial wastes are in use as alternative fuel and consequently briquettes of granulated used banknotes may take the same place.

Cement factories normally will have to comply with emission regulations and the burning of briquettes will not change that position.

Coolant for the steel industry.
Worldwide the production of steel commonly is based on the Linz-Donawitz process, named after the steel plants in the homonymous towns where this process was used for the first time. The process is based on blowing pure oxygen into the steel in the melting pot, which generates a large amount of energy and thus produces the so-called oxysteel. In order to cool down this oxysteel various materials must be added to the melt as extra mass with the effect that the excess energy is used for the ignition and burning of the injected materials. As often wood is used for this purpose banknote briquettes could be a good alternative as they are quite comparable to wood.

<u>Paper recycling</u>
It is possible to recycle notes back into paper. Recycled notes have been used as novelty paper.

Recycling polymer notes

Polymer notes can be recycled. The shredded polymer notes can be extruded and palletized at high temperature. This process melts the polymer and inks and mixes them in a homogenous blend. These pellets are used in injection moulding to make such items as compost bins, flowerpots, power sockets and plumbing supplies.

From banknote production to power socket