Recycling of Aluminium Cans

ATM Recyclingsystems offers innovative solutions

Aluminium beverage cans have become indispensable in today's society. In this context, it is important to keep an eye on the recycling of cans. ATM Recyclingsystems offers high-tech recycling machines for this individual application.

Aluminium is almost 100% reusable, which is another reason that speaks for its recycling. The recycling of aluminium products is a possible method for secondary metal extraction. With this kind of metal extraction, up to 95% of the energy that is needed for the primary extraction of aluminium (primary extraction 174 GJ/t Al) out of bauxite can be saved (secondary extraction 20 GJ/t Al). Additionally, there are much less greenhouse gas emissions than with the primary method (primary extraction 204 kg CO_2/t Al, secondary extraction 12 kg CO_2/t Al). [1]

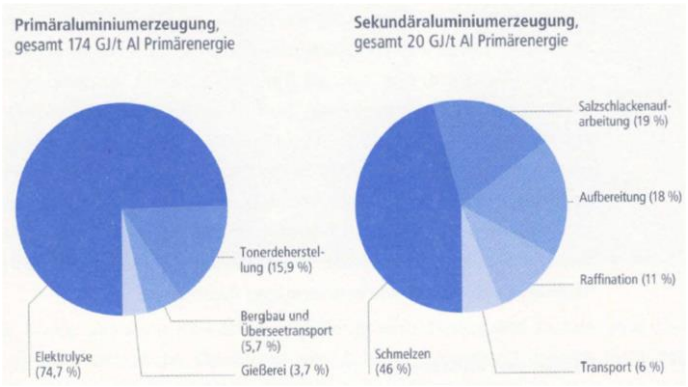

Image 1: Energy required for the primary and secondary production with regard to 1 t Aluminium] [1]

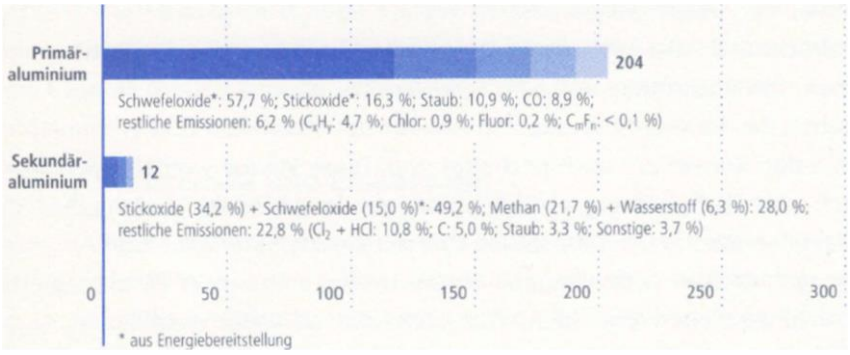

Image 2: Atmospheric emissions with primary and secondary production with regard to auf 1 t Aluminium [1]

Even though the recycling of aluminium cans is only a part of the secondary way, it is very specific. Before the aluminium can be recycled, the cans have to be prepared.

To begin with, the scrap has to be crushed and sorted. Then, the cans are pressed in bales and shredded. This compacting step has the benefit of achieving a higher bulk density (500 kg/m³) as opposed to loose cans (100 kg/m³). With high-performance baling presses, 1000 kg/m³ can be achieved.

This process benefits the environment since it improves storage, transport, charging capability and melting behaviour. Furthermore, bales have much lower space requirements and shield the scrap from moisture (when stored outside), which has a positive impact on the melting behaviour. Enclosed water (also in the form of snow or ice) as well as surface moisture are a safety hazard since the transfer of water from a fluid to gaseous state is related to volume expansion. Thereby, one litre of water can become 1400 litres of water vapour. With high amounts o aluminium and water, there can be severe reactions which can cause material ejection or, in the worst case, the destruction of the furnace. [1] [3] [4]

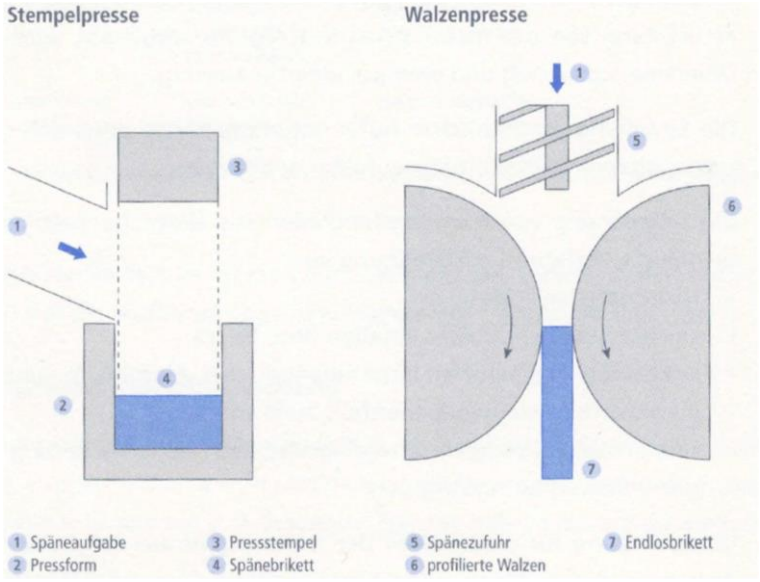

Image 3: Schematic of a stamp and roller press [1]

For the compaction, stamp presses, roller presses and, where more power is required, baling presses are used.

Image 7: Baling press from ATM Recyclingsystems and result can baling

The shredder itself consists of a steel housing with striking elements responsible for crushing. The elements are attached to the rotors, which are installed horizontally in the steel housing, either in a pendulum or jointed fashion. The feeding is carried out via rollers, the shredding via the horizontally placed rotor. [1] In addition to baling presses, ATM also produces innovative shredder solutions for optimal results in the recycling process.

Image 8: Single shaft shredder from ATM Recyclingsystems

After the shredding, the material is sorted. During sorting, the main focus is on the separation of loose contamination. The separation is done with a magnetic and an eddy current separator.

Beverage cans do not only consist of aluminium, but can also contain tinplate. The tinplate is separated from the shredded scrap with the help of a magnetic separator. With the eddy current separator all remaining loose contamination (organic, plastic, etc.) is removed. As a system integrator, ATM is able to plan overall concepts for sorting which meet all requirements of different materials after shredding.

The following step in the process is the pyrolysis of organic contamination. Typical examples thereof are colours, lacquers and remains of foods but also small amounts of paper or plastic sheet which cling to the material because of remaining moisture. In the course of pyrolysis, it has to be kept in mind that the process is carried out in a way that is gentle to the can so that its surface is prevented from oxidation. Therefore, the aluminium scrap is placed on a vibrating filter band and is thermically treated at 520 °C. At this temperature, the different layers of lacquers or organic additions dissolve. Afterwards, remaining debris that develops during the combustion process is removed by sieving. The aluminium scrap is then melted and further processed. [1] The abovementioned process can be carried out in several ways. Some of them will be discussed in the following sections.

In Europe, it is common to put the can as a whole in a salt bath or forehearth furnace during the melting process. However, there is the possibility to separate the lid from the can through thermic processing during pyrolysis. The reason for that is that the lid consists of AlMg5 while the body of the can consists of AlMg5 and that the lid's alloy starts to get brittle at a temperature of 580°C while the body's alloy needs about 50°C more. This characteristic can be described as selective embrittlement of materials. By circulating in a rotary drum, the lids can be separated. [1] [2]

A further process is the so-called „VAW-Prozess“ (Vereinigte Aluminium Werke). Thereby, the aluminium cans are pressed into bales and then directly inserted in the multi-chamber furnace. The pyrolysis of organic material and lacquer coats takes place in the forehearth area in a closed chamber [1].

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Image 9: ATM offers baling presses with dosing and conveying systems for all requirements.

During the chamber furnace process, the cans are separated from unwanted components by magnetic separation. Furthermore, the scrap is inserted in the chamber furnace via charging baskets which are heated over the hot gas stream. The occurring exhaust gases are burned in a separate area. The thereby released energy (warmth) can be fed back to the pyrolysis process, which leads to a conservation of energy. [1] [2]

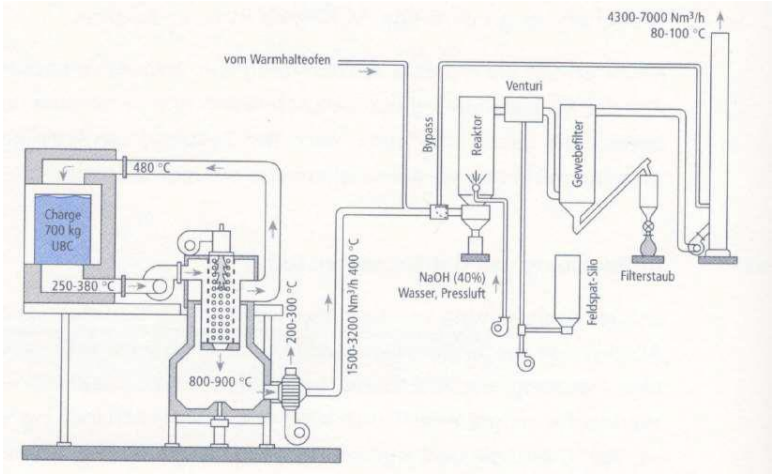

Image 4: Schematic of the chamber furnace process [1]

During the DECOATER-process, the pressed bales are put into the shredder. With the help of decomposition, inner lacquer coats are laid bare. As already mentioned, the scrap is separated from contamination by means of magnetic and eddy current separation.

Furthermore, the aluminium scrap is placed on a vibrating filter belt and thermically treated. The lacquer coats are dissolved and combustion residues are screened out. In the next step, the scrap can be inserted in the forehearth of the melting furnace. [1]

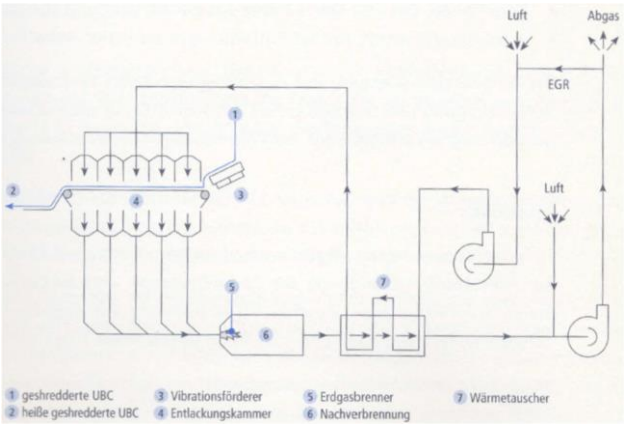

Image 5: Schematic of the DECOATER-Process [1]

A further possible treatment process is the use of rotary dryers which includes a continuing thermal removal of lacquer coats and organic connections in torque tubes. This process is suitable for scrap types with a high level of impurities. The drum which is used for scrap handling is heated by a hot gas flow. The lacquer coats and organic residues are vaporized and are screened out. After the thermal treatment, the aluminium scrap can be directly inserted in the 3-chamber melting furnace. [1]

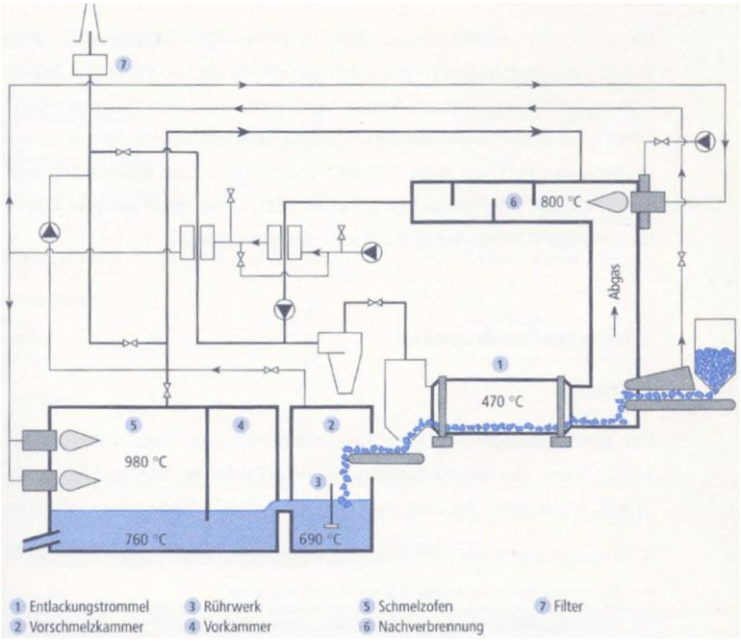

Image 6: Schematic of an integrated recycling system [1]

The following statistic gives a feeling for the amount of aluminium scrap that accumulates. In 2017, almost 31 billions (with reference to EU and EFTA states) of beverage cans were recycled (equals 420.000 to of aluminium). In comparison, 457.000 tons of aluminium can scrap (34 billions of cans) were recycled in 2018. [5] [6]

[1] Krone K. (2000): Aluminium-Recycling: Vom Vorstoff bis zur fertigen Legierung. Düsseldorft: Aluminium-Verlag.
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[4] Tom Rosenhagen, Anke Höbelmann (2020): Nachhaltiges Recycling von Aluminium-Getränkedosen un einem vollintegrierten Aluminiumrecyclingwerk. Hg. v. Bernd Friedrich. Neuruppin. Online verfügbar unter https://www.vivis.de/wpcontent/uploads/RuR13/2020_RuR_308-323_Rosenhagen.pdf.
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[7] Paketierpresse von ATM Recyclingsystems und Ergebnis der Dosenpaketierung
[8] Einwellenschredder von ATM Recyclingsystems
[9] Arno®Press K