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ASR recycling technology makes advancements

by Irwin Rapoport

Fifteen million tons of scrap automobiles, appliances and other light metal products are shredded annually in the United States. Twelve million tons are recycled, leaving the country's 200 automobile shredding facilities searching for a viable economic model in order to recycle this automobile shredder residue (ASR).

With nearly 220 million registered vehicles in the United States, the amount of ASR has been consistent for the past two years.

It is the three millions tons (20 percent) of shredder residue (SR) – approximately one percent of the total waste placed in landfills annually – that presents a problem.

The SR can either be recovered by either converting it into liquid or gaseous fuels or by recovering the actual rubber and plastic products.

"They are expensive," said Bob Boughton, a senior hazardous substances engineer with the California Department of Toxic Substances Control. "The economics don't work well in the U.S. and that is mainly why nobody is doing anything with it. It just costs too much to try and separate the materials before you shred by dismantling or after you shred materials, which are just so co-mingled and maybe have too many different constituents in it, which is very difficult to manage.

"The other twist is that most of the shredders are also shredding appliances and scrap steel, so maybe 50 percent of SR comes from automobiles," he added. "We are also getting plastic and rubber from all these other materials – various appliances – all being mixed together and this is happening almost everywhere in the country."

Of the 50 states, only California has labeled ASR as a hazardous waste and requires

special steps to prepare it prior to being deposited in landfills.

For the other states, only when PCB and other materials are found at certain levels, do national and state legislation kick in to deal with them.

Due to concerns about levels of leachable heavy metals, California implemented its requirements.

“It could be sent to a hazardous waste landfill, but that would be expensive,” said Boughton, “so everyone here is treating their residue with some silicate-type treatment and Portland cement and cement kiln dust fly ash solidification materials that reduce the heavy metals from leaching. Then they can landfill it as regular garbage.”

European nations are seeking solutions due to recycling mandates imposed by the European Union. Currently EU nations are recycling 75 percent of automobiles – copper, aluminum and steel. The EU mandate requires an 85 percent level, which will eventually be raised to 95 percent.

Product stewardship is seen as one way of reducing ASR levels.

“One way is to reduce the materials in the manufacturing of the car at the beginning, but that is counter to putting more plastics on vehicles to make them lighter weight so that you get better gas mileage,” said Boughton. “So instead of having all the different types of plastics, they are trying to just get several types, make cars easier to dismantle and to exchange parts, but you are going to have 10 year old cars that are ending their service life, which is generating SR right now. This is really a problem.”

In addition to dismantling, creating fuel and recycling plastic and rubber, glass and inert dirt material is being studied as an aggregate for asphalt and concrete, and soil application.

While these measures are costly, Boughton says they are being pursued because legislation is serving as a “driving force and they are having to eat the cost as far as the automakers. I don’t think anyone in the United States is currently recovering anything for SR, although several groups are studying ways to do it.”

Research on the use of ASR is being conducted by car and major automobile manufacturers, as well as the Argon National Labs, which is studying processes and has actually recovered the foam in some plastics for re-use.

“They are still fine tuning those processes – nobody is doing anything full-scale,” said Boughton. “It’s pretty easy as far as technology to convert materials into liquid or gas fuels or to just burn it like you can burn garbage, but nobody is really doing that. People have tested it as a fuel after processing such as steel mills and other specific applications, but the problem is that you have to get all the chlorine out; you have to clean it and do several separations. By the time you do that, it becomes a ridiculous cost.

“The problem in California and other states is that it is still reasonably cheap to landfill –

the average cost is $35 per ton," he added. "In the eastern United States it may cost $100 a ton to landfill. There are probably better economics there for recovery of shredder residue."

Nor does Boughton see any national leadership to deal with the ASR problem.

"It's one of those 'not really a problem' issues," he said, but noting that several years ago that the federal and state governments expressed an interest in using SR as alternative spread to cover garbage at landfills due to its inert qualities and inability to catch fire.

While an agreement with dismantlers has been signed to remove mercury switches, which should help to reduce mercury emissions in shredders, as well as mercury residue, action is still needed on other metals that are used in automobiles.

Boughton is hoping that individual states and the federal government will offer tax credits, incentives and subsidies to help reduce the amount of ASR ending up in landfills.

It's not for lack of trying that a use for ASR has not been found. Texas Industries worked with Star Recycling to convert SR into a cement kiln fuel, but failed. Schnitzer Steel in California, over the last 20 years, has reviewed all sorts of ideas from direct burning to plastics recovery, but none of the experiments has translated into a successful economic model.

"It's very difficult in California to site facilities that would burn ASR or to make a liquid or gas fuel because of resulting air emissions," said Boughton. "We have unique barriers here."

In Japan, where land is precious, measures are being taken to recycle ASR.

"They do some pyrolysis and recover energy value, and some firms are making nuggets out of the remaining soil and glass residue," said Boughton. "That is useful as aggregate for road bases, but it takes a lot of energy to do it and the economics are not that good. But when you have no landfills, you are driven to that."

Zmag America, Ltd., the American branch of Japan-based Zmag Ltd., is introducing its ASR recycling technology to the North American market.

"Our technology includes various kinds of separation technologies," Eishin Takahashi. "We plan to introduce magnetic separators, stainless steel separators, non-ferrous metal separators, and others. Zmag is considering licensing of its technology, which has an American patent, and the sale of complete systems.

"Licensing our solution would make sense to customers who want to utilize their current equipment," said Takahashi. "The price of our systems will be different depending on customer system configuration."

A Zmag recycling system can recycle four tons of ASR per hour. Approximately 10 percent of ASR consists of non-ferrous metals, which can be sorted, sold and recycled. The

remaining portion of ASR, excluding sand and such, can be converted into fuel. Values are determined by applying the cost of the mixed metals and the re-sale price of ASR as fuel.

“Our technology can be used in conjunction with other companies’ technologies such as gasification technology,” said Takahashi. “Even for gasification, conducting thorough recovery/separation is ideal because automobiles are made up of various kinds of materials. The water content in the Zmag-treated ASR was found to be stable and smaller than or equal to one-per-cent, which is considered to be very attractive as pre-treatment of the gasification technology.

“Because our technology is based on thorough separation/recovery, metal recyclers, shredding companies and metal distributors would benefit with our technology,” he added. “Automobile manufacturers can position themselves as a leading player in the recycling field. In the EU and Japan, automobile recycling legislation is already in effect.

Combined with Zmag’s ASR recycling technology, the 95% weight wise automobile recycling rate can be achieved. Cement, steel and paper manufacturing industries, as well as electrical utilities, would benefit because ASR has a high heating value and can be substituted for coal.”

For further information, visit dtsc.ca.gov/TechnologyDevelopment.

877-777-0737 • Fax 419-931-0740 • 118 E. Third Street, Suite A Perrysburg, OH 43551