THE RECYCLING OF METALLIC SCRAP IN CROATIA

B. Salopek[1] & G. Bedeković[1]

[1]Faculty of Mining, Geology and Petroleum Engineering – University of Zagreb - Pierottijeva 6 – 10000 Zagreb – Croatia –

ABSTRACT

The main part of the needed metal in the Republic of Croatia is secured by collecting and recycling of metallic scrap, and a part is imported. By collecting and recycling in the year 1998 altogether 113.828 t of various metallic waste has been produced. The iron and steel scrap, which composes 90 % of the whole material, is renovated in two steel plants which in the year 1998 produced 104.114 t of raw steel. With the aim to collect a maximum of metallic scrap a waste stock market has been organized, and 1995 a recycling plant also has been erected. In the paper figures about the import and export of metals in Croatia are given, the technology of the recycling process is reviewed together with the basic figures, and the environmental protection measures in the plant are represented.

INTRODUCTION

In the Republic of Croatia there are no more metallic deposits except of bauxite, the other ones are exploited. A part of the need metal is secured by collecting and recyslinge of metallic scrap, and a part is imported. 1998 by collecting and recycling a load of 133.828 t of various metals has been gained, what is 20 % more than the average of the past ten years. The iron and steel scrap, what is 90 % of the whole scrap, is manufactured in the steel works in Split, with a capacity of 200.000 t, and with smaller capacity of 70.000 t in Sisak. In the year 1998 both these plants produced altogether 104.114 t of raw steel, while the average yearly production has been relatively modest and reached 65.850 t yearly. The share of the steel scrap in the metallic charge during the 80-ies was higher than 40 % and today it is, depending on the manufacturing technology, 20 to 30 % (Converters), 50 to 60 % (SM-open hearth) and 95 to 100 % (ELP-furnaces). There are many reasons for the use of steel scrap (Sofilić et al., 2000.):

- lower production costs compared with the costs using pig-iron resp. ore proper,
- lower costs because of the direct treatment in steel-works,
- higher productivity in relation with the classic cycle,
- shorter production cycle and higher furnace productivity,
- lower environmental pollution.

The largest part of the iron and steel scrap was collected in the region of Croatia proper, and about 17.000 t was imported. 29 firms are engaged in the import of metallic scrap, and in the metal export 53 firms. In Table I the export and import of metal scrap is presented and in Table II a review of the individual partner countries is given.

Table I Metal import and export for the year 1999

METAL	IMPORT		EXPORT	
	t	%	t	%
Fe	6734	97,2	101093	88,39
Cu	26	0,4	6783	5,93
Al	116	1,7	5563	4,86
Pb	46	0,7	499	0,44
Zn	0	0,0	413	0,36
Sn	0	0,0	25	0,02
TOTAL	6922	100,0	114376	100,00

Table II Review of the individual partner countries in the metal import-export

COUNTRY	IMPORT		EXPORT	
	t	%	t	%
Austria	373	5,38	5557	4,8
Bosnia and H.	3184	46,00	293	0,3
Italy	601	8,68	66076	57,8
Germany	2706	39,10	2629	2,3
Slovenia	40	0,58	38388	33,6
Others	18	0,26	1433	1,2
TOTAL	6922	100,00	114376	100,0

With the aim to collect a maximum of metallic scrap a waste stock market has been organized, and 1995 a

recycling plant also has been erected. Besides scrap which were collected in the Republic of Croatia, in the recycling plant are processed scrap from the surrounding countries which haven't got that kind of treatment.

THE RECYCLING OF METALLIC SCRAP

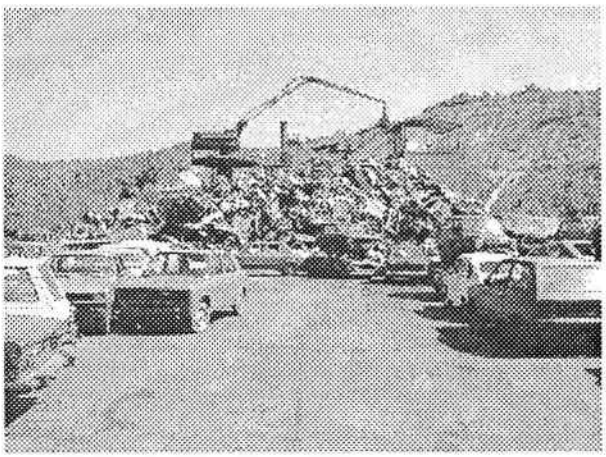

Fig. 1 Equipment for metallic scrap recycling

The equipment for recycling of metallic scrap is positioned (Fig. 1) in Zagreb, capitale of Croatia, on the premises of a former cement factory. The place occupied by the equipment with the accompanying facilities takes up approximately 0,3 ha, and is in function from 1996. Daily are treatment some 80 t of various scrap, chiefly old cars, and the rest are discharged kitchen utensils, metallic scrap of all kind, sheet metal, cans etc.

Table III Number of cars in Croatia – total, new, and recycled

Year	Totally registered	The first time registered	Recyclied	SRN
	Unit	Unit	Unit	%
1996.	840910	74203	23293	31,39
1997.	939076	112164	13998	12,48
1998.	1001327	85980	23729	27,60
1999.	1065985	89916	25258	28,09
2000.	1104152	58132	19965	34,34

The data for the year 2000 corresponds with the day of 30.6.2000. The number of the recycled cars can be seen in Tab. III. Of three new cars in Croatia just one old is recycled, what's lesser than 30 %, while e.g. in Japan that relation (SRN) in the early 90-ties rose up to 70···75 %, what means that of four new cars three old ones are recycled (Koga et al., 1997.).

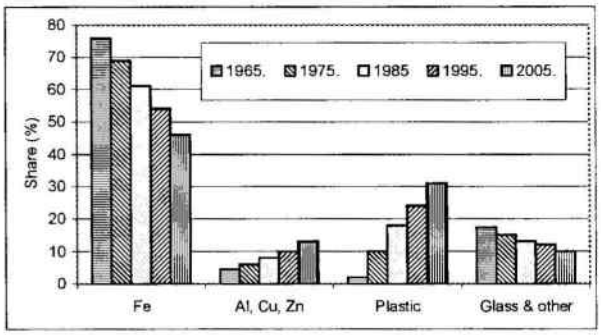

Fig. 2 Material participation in passenger cars

From the diagram in Fig. 2 it can be seen that the share of iron in passenger cars is reduced from approximately 75 % in the 60-ties to near 55 % in the 90-ties, while the share of the other metals during the same time increased (from 5 to 10 %), and the share of plastic even 12 times (from 2 to 24 %). It is espected that such a trend will be continued in the future, too.

The Technical Process

The recycling process for old cars by dismembering is shown easy to survey on the flow-sheet in Fig. 3. After the accumulators are removed and the fuel and oil is let out, the old cars are by baggers thrown in the trough-receiver ***1***. Here the wreck is lateral pressed and aqueezed to a width of 1300 mm and then passed between a pair of rollers ***2***, where it is further squeezed and so formed enters a crusher ***3***. The feeding intensity of the crusher my be regulated by velocity alterations of the crusher's dosimeter. The crusher consists of a drum with pending hammers and a grizzly with a hole-size of 100 x 100 mm for the crushed material and a special opening for firmer and larger bits of metal which cannot pass the grizzly. The from rotates by a velocity of 600 rot/min; during the rotation the hammers are beating the material crushing it. The crushed material enters over a vibro-dosimeter ***4*** and a belt-conveyor in an air separator ***5***, where the "light component" (textile, plastic, rubber) is removed, while the "heavy component" (various metals) goes in a magnetic drum ***6***. The separated magnetic component is further cleaned manually on a picking belt ***7a*** from present nonmetallic material, rubber bits with steel armature, wires etc. (large scrap); so purified, the magnetic component goes to the stock-pile for iron. The nonmagnetic component goes over a magnetic belt separator ***8***, where the remaining iron is removed, to a so-called eddy-current separator ***9*** for a further cleaning. Here two products are separated: prochrom from which on the picking belt ***7b*** the still remaining nonmetallic material (large scrap) are removed, as well as ***7c*** bits of aluminium, brass, copper and zinc, what is stored into special conteiners.

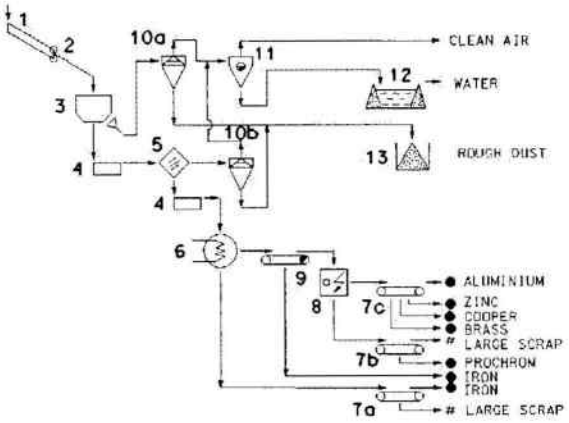

Fig. 3 Segregative flowsheet of metallic scrap processing

By such method of metal-scrap separation 60···65 % iron and steel can be gained, and up to 8 % of other metals (predominantly aluminium and cooper), the rest is nonmetallic (rubber, plastic, textile), dust and mud.

The dedusting system consists of two aerocyclones and one Venturi scrubber. Besides that, there is still the crusher ***3*** and the aeroseparator ***5***. The polluted air is from the crusher by tubes led for cleaning to the aerocyclone ***10a***, and the air from the aero classificiator to the other aerocyclone ***10b***, where from the rough dust (the Apex-product) is by a rail transporter deposited to the conteiner ***13***. In that way cleaned air (the Vortex-product) from both aerocyclones additionally is cleaned in the wet Venturi scrubber ***11***. The clean air is let out through the chimney into the atmosphere, and the water with the finest particles is by a conical collector led to the purifying equipment. The purified water is again used (recircularized) in the Venturi scrubber, and the mud is by a continous transporter sedimented to the pond ***12***. The dedusting system has a daily capacity of up to 10 t dust if the air flow through the plant is 40.000 m^3/h.

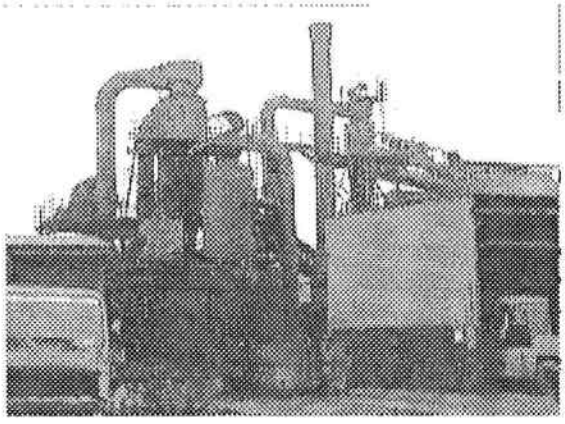

Fig. 4 Part of the equipment with the dedusting system

Environmental protection

Dust and the solid scrap and waste separated during the separation process is daily by trucks taken away to the communal dung-pit. The sedimentation pond is of a big enough capacity, so it is cleaned each 30 to 40 days, and then by truck-cisterns the content is transported to the mentioned dung-pit. The water from the sedimentation pond is returned to the process. The physical and chemical characteristics of the solid scrap, the mud, and the liquid from the scrubber are determined monthly. The analysis gives results with regard to pH, conductivity, concentration of phenol, cyanide, nitrite, fluoride, ammonia, heavy metals (10 elements), total organic carbon and the chemical oxygen consumption. The established values are not exceeding the approved concentrations for a deposit of I. category, that is, the deposition on the communal dung-pit is permitted. The water quality which flows off from the working surface of the processing plant is analysed twice yearly. After the to date executed analyses the waste water satisfies the prescribed rules, so it can be emptied into the public canalization without any special treatment. The noise immision (60 dB) as well as that of dust (II. category of air quality) in the equipment environs are on a level with the prescribed values.

CONCLUSION

In the Republic of Croatia the production of steel as well as of other metals totally is based on raw materials gained by the recycling of metallic scrap. With that aim, besides a waste-stock-market, a special recycling plant, too, has been erected which daily works up approximately 80 t of various metallic scrap, mostly old cars. Today in Croatia for three firstly registered automobile one old car is recycled, or approximately 30 %, what is very much below the results in developped nations. A law is being preparred by which car owners shall be stimulated to let over old cars to authorized firms for scrap collectig, resp. the dealer shall have the obligation to take over the old automobile.

The measures for the protection of the environment are carried out in the manner habitual in that producion branch. All emission and immission parameters satisfy the existing legal regulations and standards. A certain problem is the steady growth of the compensation for the take-off large waste, dust and mud to the communal dung-pit: today tha charge is already 35 US$. In the next period efforts will be undertaken to reduce the quantity of that waste (Langer, 1999, Dillman and van der Beck, 1997), and that by improvement of the existing resp. by introduction of new methods in the recycling process.

REFERENCES

Dilman, J., van der Beek, A., Exploitation and preparation Posibilities of automobile shredder residue. XX. Int. Mineral Processing Congress, Aachen, Vol. 5, 201- 208, 1997.

Langner, J., Sustainable product design: Recycling of automotive components and composite material. REWAS` 99, Global Symp. on Recycling, Waste Treatment and Clean Tech., San Sebastian, Vol. II.1817-1823, 1999.

Koga, Y. et al., A Recovering System of Valuable Metals from Shredded Automobiles. XX. Int. Mineral Processing Congress, Aachen, Vol. 5, 177- 188, 1997.

Soifilić, T., Rastovčan-Mioč, A. and Cerjan-Stefanović, Š., Problems of radioactivity in steel waste. 2. Int. Conf. on nodular cast, Sisak, 67-72, 2000. (In Croatian)