
TUSTI
high tech recycling

Recycling of sealant tubes

TUSTI has performed a preliminary quick scan to study the recyclability of sealant tubes. Several tubes were supplied by SUEZ. These tubes were categorized on type of sealant: acrylic sealants, silicone sealants and other (e.g. MS) construction sealants.

The wood fillers (pointed with an arrow in figure 1) were left out of this investigation: this short research focuses on the HDPE sealant tubes.

Figure 1: *Sealants, sorted by type of sealant. Left: acrylic. Middle: silicone. Right: Construction sealants (mainly MS polymer) and others.*

First, the type of plastic was determined using IR analysis (Figure 2). Every tube consists of the white tube itself, a semi-transparent insert and a semi-transparent nozzle.

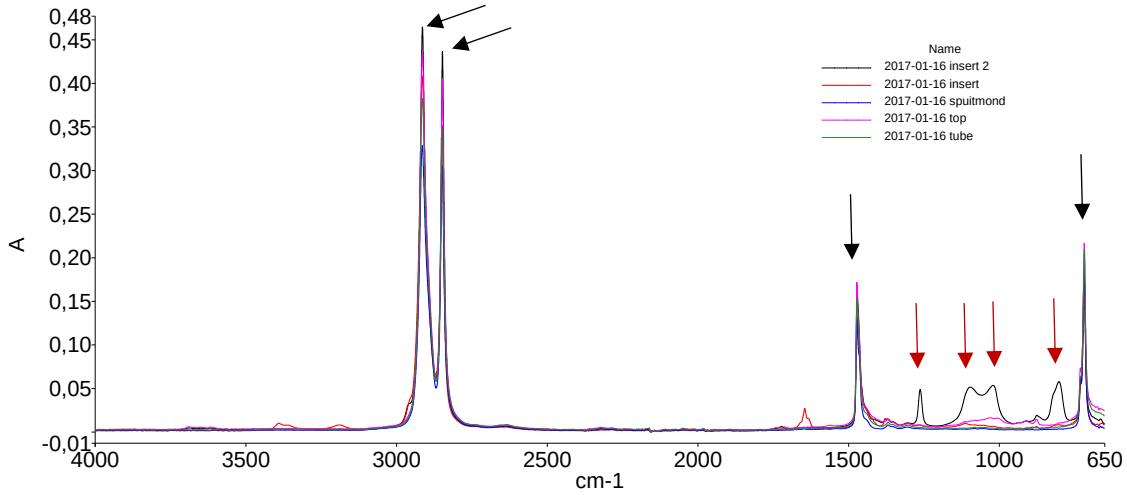

Figure 2: *IR spectra of plastic parts (see Legenda).*

The black arrows point towards the peaks that are associated with PE. The red peaks point towards silicone peaks. This analysis shows that all parts consist of PE. Most probably, the tube itself will be HDPE, and the semi-transparent parts are likely LDPE. The recycled plastic will therefore be a mixture of HDPE (mainly) and LDPE.

The sealant tubes were opened to determine the amount of residual sealant and the amount of plastic. These results are summarized in table 1. Three tubes from every type of sealant were opened to determine the average tube weight. The weight of the remaining tubes was determined without opening. Using the average tube weight, the amount of remaining sealant was estimated.

Table 1: *Amount of plastic and remaining sealant per type of sealant tube.*

Type	Sample nr	Total mass	Mass plastic		Mass sealant	
		(g)	(g)	(%)	(g)	(%)
Acrylic	1	48,78	48,01	98%	0,77	2%
Acrylic	2	159,62	49,01	31%	110,61	69%
Acrylic	3	169,64	49,50	29%	120,14	71%
Acrylic	4	112,34	48,84	43%	63,50	57%
Acrylic	5	145,30	48,84	34%	96,46	66%
Acrylic	6	152,28	48,84	32%	103,44	68%
Acrylic	7	170,19	48,84	29%	121,35	71%
Average			48,84	36%	88,04	64%
Silicone	8	115,17	55,02	48%	60,15	52%
Silicone	9	204,19	46,99	23%	157,20	77%
Silicone	10	117,03	51,49	44%	65,54	56%
Silicone	11	82,61	51,17	62%	31,44	38%
Silicone	12	183,57	51,17	28%	132,40	72%
Silicone	13	291,10	51,17	18%	239,93	82%
Average			51,17	31%	114,44	69%
Construction	14	90,29	72,09	80%	18,20	20%
Construction	15	70,18	52,97	75%	17,21	25%
Construction	16	198,75	55,70	28%	143,05	72%
Construction	17	197,22	60,25	31%	136,97	69%
Construction	18	182,30	60,25	33%	122,05	67%
Construction	19	291,23	60,25	21%	230,98	79%
Average			60,25	35%	111,41	65%

On average, the tubes contain more sealant than plastic. This is a large constraint in the recycling of these tubes: transportation costs will be high, as well as costs for disposal of the sealant waste.

Since the amount of remaining sealant is very high, no tests were performed to dissolve of chemically change the sealant: this would require large amounts of solvent and/or chemicals, which makes the recycling process expensive, energy-consuming and would yield large amounts of chemical waste.

However, it was found that in 8 out of the 9 openend samples, the sealant was completely hardened. The adhesion between sealant and tube is weak, the hardened sealant can therefore easily be removed, and will be removed from the surface when being shredded. The solution for recycling sealant tubes should therefore be found in hardening the sealant, in stead of dissolving it.

Hardening the sealant is a process that will occur when the sealant is exposed to air, for example by pressing the sealant tubes or pre-shredding them. The process can be accelarated chemically (which was not studied yet). Alternatively, it may be possible to harden the sealant by making it cold, for example by shredding at low temperatures or mixing it with solid CO_2 pellets. A small test should be performed to study the feasibility of this idea, be placing some sealant tubes in the fridge for a few hours at -20 °C, or be receiving temperature dependent rheology data from sealant suppliers.

Assuming that all sealants can be made solid, it would be interesting to see whether the plastic parts (PE) can be easily separated from the sealant. Therefore, a simple floating test was performed. Water is used in many factories to separate PE or PP from other materials. Plastic parts and hardened sealants were placed together in a glass container. The result is shown in figure 3.

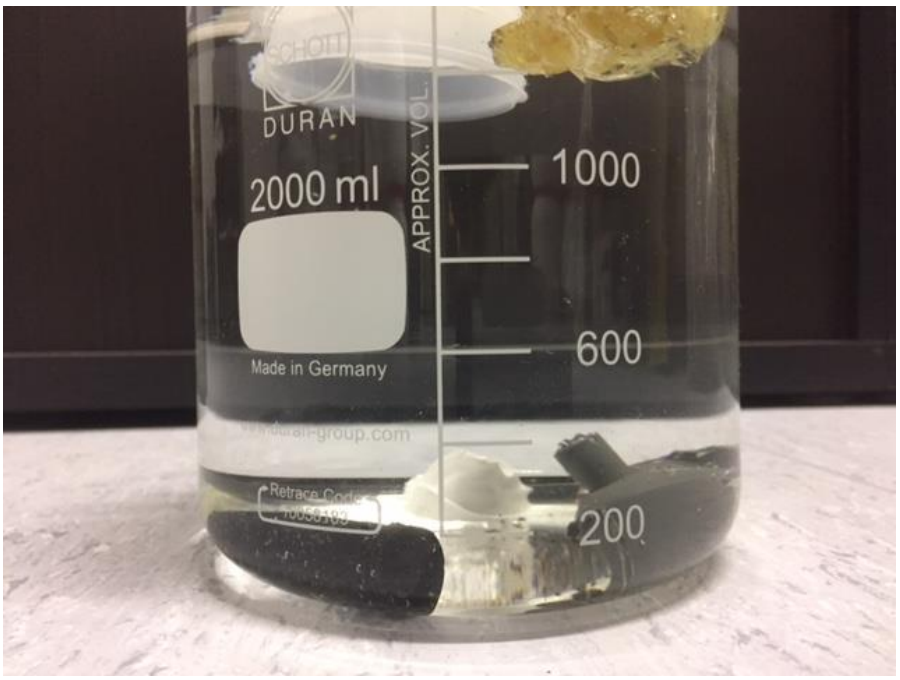

Figure 3: *Sealants and plastic parts in water: Floating: PE cap and polyurethane sealant. Sinking: MS Polymer sealant (black), Acrylic sealant (grey) and silicone sealant (white).*

The polyurethane sealant (supplied by Wurth) is the only floating sealant found so far. It would be very advantageous if a solution could be found to leave those types of sealants out.