

Appendix on how life-cycle assessment was modeled in the LCA toolset SimaPro for the article:

Comparative life-cycle assessment for renovation methods of waste water sewerage

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Note: weight per functional unit has been calculated using the information gained from the references (listed as reference value) in combination with content specifications (as listed under content). References are the source of the reference value in the tables below. The “Modeled with” column refers to how it was modeled in the LCA toolset SimaPro.

CIPP-Lining

Consumables

Consumable	Content	Reference value	Weight [kg]/FU	Modeled with	References
Bags¹	Polyethylene	50 bags/house	6.78	Polyethylene low-density granulate (PE-LD), production mix, at plant RER	(Larsson and Klovus, 2013)
Cloths²	Cotton	1 pallet/week	50	Textile, woven cotton, at plant/GLO U	(Larsson and Klovus, 2013)
Gloves 1: Vinyl³	Nitrile	3000 pairs/week	21	Nitrile-compounds, at regional storehouse/RER U	(Larsson and Klovus, 2013)
Gloves 2: 4H⁴	Polyethylene	20 pairs/house	2.68	Fleece, polyethylene, at plant/RER U	(Larsson and Klovus, 2013)
Gloves 3: Dish⁵	Nitrile	24 pairs/house	2.4	Nitrile compounds, at regional storehouse/RER U	(Larsson and Klovus, 2013)
Gloves 4: Ninja⁶	Nylon Polyurethane coating	1 package/house	0.6	*Nylon 66 granulate (PA 66), production mix, at plant RER *Polyurethane, rigid foam, at plant/RER U	(Larsson and Klovus, 2013)
Hose clamps⁷	Mild Steel	2 packages/house	8.6	Steel, low-alloyed, at plant/RER U	(Larsson

¹ Technical information regarding K-3 bag/Plastic cover manufactured by Trioplast [Online]. <http://trioplast.com/product-catalog/products/>. [Accessed 20th November 2013].

² Cloth technical informationsheet [Online]. <http://www.textilputs.se/index.asp?mainId=132&cat1=136&show=136>. [Accessed 17th of December 2013].

³ Ansell TouchNTuff 92-500 technical informationsheet.

⁴ Production address, routes and technical information about the 4H glove.

⁵ Sol-Vex product sheet [Online]. <http://www.ansellpro.com/product-catalog/ProductDetail.aspx?productId=165>. [Accessed 19th of December 2013].

⁶ Ninjagloves comparison chart including product specifications on Ninja Flex gloves. http://www.ninjagloves.com/docs/Comp_chart.html.

⁷ Product information of hose clamps from Jubilee clips.

					and Klovus, 2013)
Lubrication ⁸	Aluminum Complex Food Grade Grease	12 tubes/house	4.8	Lubricating oil, at plant/RER U	(Larsson and Klovus, 2013)
Plastic buckets ⁹	Polypropylene	30 units/house	11.2	Polypropylene, granulate, at plant/RER U	(Larsson and Klovus, 2013)
Plastic cover ¹⁰	Polyethylene film	6 rolls/house	72.3	Polyethylene, LLDPE, granulate, at plant/RER U	(Larsson and Klovus, 2013)
Preliner ¹¹	Polyethylene film	50 meters/house	9.15	Fleece, polyethylene, at plant/RER U	(Larsson and Klovus, 2013)
Primol ¹²	White mineral oil	2.5 liters/house	2.2	White mineral oil, at plant/RNA	(Larsson and Klovus, 2013)
Protective cardboard ¹³	Paper	346.1 m/house	65.4	White-lined chipboard, WLC, at plant/RER U	Esimate
Rope ¹⁴	Fibers	35 m/house	5.5	Viscose fibers, at plant/GLO S	(Larsson and Klovus, 2013)
Scrubs ¹⁵	Fleece Liquid: 80% Water 20 % Alcohol	10 buckets/house	1.54 6.16 1.65	*Fleece, polyethylene, at plant/RER U *Tap water, at user/RER U *Benzyl alcohol, at plant/RER U	(Larsson and Klovus, 2013)
Silicone ¹⁶	Silicone	30 m/house	30	Silicone product, at plant/RER U	(Larsson and Klovus, 2013)
Straps ¹⁷	Polypropylene product	117.2 m/house	8	Polypropylene fibers (PP), crude oil based, production mix, at plant, PP granulate without additives EU-27 S	(Larsson and Klovus, 2013)
Stripes ¹⁸	Nylon	5000units/5 houses	0.49	Nylon 66, at plant/RER U	(Larsson and Klovus, 2013)
Tape ¹⁹	PVC film Rubber	1463.7 meters/house	14.2 0.746	*PVC calendered sheet E *Synthetic rubber, at plant/RER U	(Larsson and Klovus, 2013)
Water	Tap water	5 m3/house	5000	Tap water, at user/RER U	(Jakobsson, 2014)

⁸ Kernite Lubrication informationsheet about Kernite Plex Clear [Online].

<http://www.kernitelubrication.com/page.asp?idpage=596&pais=33&idioma=15>: Kernite Lubrication. [Accessed 10th of January 2014].

⁹ Product informationsheet regarding Emsafe 11.2 l buckets [Online].

http://lagan.emballator.se/sites/elp.emballator.se/files/sidfiler/Emsafe_en_0.pdf: Emballator Lagan Plast AB. [Accessed 10th of January 2014].

¹⁰ Technical information regarding K-3 bag/Plastic cover manufactured by Trioplast [Online].

<http://trioplast.com/product-catalog/products/>. [Accessed 20th November 2013].

¹¹ Valéron Preliner productsheet [Online].

http://www.valeron.eu/Portals/0/PDF/1845_LR_Valeron%20IL-SPR_PFF_UK.pdf:

¹² MedicWay 68 productsheet/safety datasheet [Online].

https://external.statoilfuelretail.com/mar/svg01184.nsf/LubProducts/medicway_68: Statoil Fuel & Retail. [Accessed 9th of November 2013].

¹³ Personal communication with Grunda AB: Product information regarding production and delivery routes of cotton cloths and protective cardboard.

¹⁴ Estimated.

¹⁵ Personal communication with ANSTETT, D. Scrubs technical information.

¹⁶ Estimated.

¹⁷ Estimated.

¹⁸ 4USE-YJ-142 Stripe product information [Online].

<http://handla.swedol.se/shop/showItemList.asp?IT3=70>: Swedol AB. [Accessed 26th of February 2014].

¹⁹ Personal communication with Ann Fakt. Electrical tape RHE 15 product information from Stokvistapes AB.

Liner assembly

Piping material	Content	Reference value	Weight kg/FU	Modeled with	Reference
Epoxy ²⁰	Epoxy Resin	Actual usage	244.9	Epoxy resin, liquid, at plant/RER U	(Aarsleff, 2013)
F-liner ²¹	Felt	Felt/liner length	93.8	*Polyester resin, unsaturated, at plant/RER U	(Aarsleff, 2013)
	Coating	Coating/liner length	36.6	*Polyurethane, rigid foam, at plant/RER U	
Cure ²²	Polyaminimidazolin 30–50% Isoforondiamin 10–30% Fenalkamin 5–20% 1,3- Benzendimetanamin 5–15% 4-tert-Butylfenol 5–15 % 2-piperazin-1-yletylamin 1–3% Trietanolamin 2–5%		120.2	*Chemicals organic, at plant/GLO U *Methylcyclohexane, at plant/RER U *Formaldehyde, production mix, at plant/RER U *Xylene, at plant/RER U *Phenol, at plant/RER U *Ethylenediamine, at plant/RER U *Triethanolamine, at plant/RER U	(Aarsleff, 2013)

Production

Tool	Reference value	kWh/FU	Modeled with	References
Camera ²³	Rigid battery Camera 1.5 batteries/day 39.6 Wh/battery	1.49	Electricity, low voltage, production SE, at grid/SE U	(Larsson and Klovus, 2013)
Compressor ²⁴	Ceccato Aria Compressa SPA Type: CSA20/8 G2, 2010 15 kW for 262.5 h	3787.5	-	Measured
Cutter ²⁵	IMS Micro Cutter Comfort 230 VAC Max 1.6 A 170 min/house	1.04	-	(Rejment, 2014)
High-Pressure unit ²⁶	Kubota V2403 M-T 44kW 5 hours/house	220	Diesel, burned in building machine/GLO U	(Jakobsson, 2014)
Mixer ²⁷	Bosch 1100W GSB 21-2 RE PRO 5 mix 1 min each for 25 days.	2.2	-	Estimation
Screwdriver ²⁸	DeWalt DCB182 18 V 4.0 Ah 72 Wh Approximately 6–7 batteries/day for 25 days.	11.7	-	(Larsson and Klovus, 2013)
Screwdriver ²⁹ (gutting)	Bosch GSB 20-2 RE PRO701 W 3 h per 2 out of 5 vertical pipes incl. apartments.	5.3	-	(Jakobsson, 2014)
Ventilation ³⁰	TFSK 125 System AIR 54W Constant for 5 weeks	45.4	-	(Larsson and Klovus, 2013)

²⁰ Aarsleff House epoxy safety datasheet [Online]. Internally at Aarsleff Rörteknik AB: Bodotex Composites ApS. [Accessed 21 November 2013.]

²¹ Personal communication with Amalie Larsen. F-Liner product information thru e-mail correspondence.

²² Aarsleff House 040 safety datasheet [Online]. Internally at Aarsleff Rörteknik AB: Bodotex Composites ApS. [Accessed 21 November 2013.]

²³ Rigid camera and battery technical information sheet [Online]. <https://www.ridgid.com/us/en/seesnake-compact-camera>: Ridgid online. [Accessed 15 December 2013.]

²⁴ Product information regarding Ceccato Aria Compressa SPAType: CSA20/8 G2. Information on the machine: Ceccato Ari.

²⁵ IMS MICRO Cutter comfort information sheet [Online]. IMS Robotics GmbH. [Accessed 19 December 2013.]

²⁶ Kubota V2403 M-T information sheet [Online]: Kubota. [Accessed 19 December 2013.]

²⁷ Bosch GSB 21-2 RE productsheet [Online]. <http://www.bosch-professional.com/se/sv/gsb-21-2-re-23289-ocs-p/>: Bosch Powertools. [Accessed 22 February 2014.]

²⁸ Bosch DCB182 18 V XR productsheet [online] <http://www.dewalt.se/attachments/productdetails/catno/DCB182/info/specifications/>. [Accessed 22 February 2014.]

²⁹ Bosch GSB 20-2 RE PRO productsheet [Online]. <http://www.bosch-professional.com/middleeast2/en/ocs/tools/101356/11753/impact-drills/gsb-20-2-re/> [Accessed 23 February 2014.]

³⁰ TFSK 125 XL System AIR unit description on site.

Transportation

Consumable	Means of transportation / Distance [km]	tkm/FU	Modeled with	Reference
Bags	Truck / 498 ³¹	3.34	*Transport, lorry 16-32t, EURO3/RER U *Transport, van <3.5t/RER U	(Ahlseff, 2013)
	Van / 52.6 ³²	0.352		
Cloths	Truck / 814 ³³	40.7	-	(Grunda, 2014) (Textilputs, 2014)
	Van / 49.3 ³⁴	2.46	-	
Gloves1: Vinyl	Truck / 529.5 ³⁵	11.1	-	(Ramu, 2014)
	Van / 49.3 ³⁶	1.04	-	
	Boat / 18193.8 ³⁷	382	*Transport, transoceanic freight ship/OCE U	
Gloves 2: 4H	Truck / 6092 ³⁸	16.3	-	(Jonason, 2014)
	Van / 49.3 ³⁹	0.132	-	
	Ship / 5888.05 ⁴⁰	15.8	*Container ship ocean, technology mix, 27,500 dwt pay load capacity RER S	
Gloves 3: Dish	Truck / 529.5 ⁴¹	1.27	-	(Ramu, 2014)
	Van / 49.3 ⁴²	0.118	-	
	Boat / 18193.8 ⁴³	43.7	-	
Gloves 4: Ninja	Truck / 529.5 ⁴⁴	0.318	-	(Ninjagloves, 2007)
	Van / 49.3 ⁴⁵	0.0296	-	
	Boat / 18193.8 ⁴⁶	10.9	-	
Hose clamps	Truck / 2106.5 ⁴⁷	18.1	-	(Loeffler, 2014)
	Van / 49.3 ⁴⁸	0.318	-	
	Ship / 8.6 ⁴⁹	0.424	-	

Scrubs	Truck / 1897 ⁵⁰	17.7	-	(Anstett, 2014)
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³¹ From Trioplast AB factory to Ahlseff in Sollentuna through Ahlseff logistics central in Hallsberg.

³² From Ahlseff Sollentuna to construction site in Uppsala.

³³ From Textilputs AB factory in Bålsta to Grunda AB in Ulricehamn to Aarsleff Rörteknik in Rotebro.

³⁴ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

³⁵ From Ansell factory in Thailand to harbor in Thailand plus harbor in Göteborg to Aarsleff Rörteknik Rotebro.

³⁶ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

³⁷ From Thailand to Göteborg.

³⁸ From Honeywell factory in Mexico to New Jersey plus from Roissy in France to Aarsleff Rotebro.

³⁹ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁴⁰ From New Jersey harbor to Roissy harbor in France.

⁴¹ From Ansell factory in Thailand to harbor in Thailand plus harbor in Göteborg to Aarsleff Rörteknik Rotebro.

⁴² From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁴³ From Thailand to Göteborg.

⁴⁴ From Ansell factory in Thailand to harbor in Thailand plus harbor in Göteborg to Aarsleff Rörteknik Rotebro.

⁴⁵ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁴⁶ From Thailand to Göteborg.

⁴⁷ From Jubilee Clips factory in Kent, England to Dover Harbor, plus from Calais, France to Aarsleff A/S, Denmark to Aarsleff Rörteknik Rotebro.

⁴⁸ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁴⁹ From Dover Harbor to Calais Harbor.

	Van / 49.3 ⁵¹	0.461	-	
Silicone	Truck / 961 ⁵²	28.8	-	(Alminer, 2014)
	Van / 49.3 ⁵³	1.48	-	
Straps	Truck / 961 ⁵⁴	7.69	-	(Alminer, 2014)
	Van / 49.3 ⁵⁵	0.394	-	
Stripes	Truck / 962 ⁵⁶	0.471	-	Estimate
	Van / 49.3 ⁵⁷	0.0242	-	
	Ship / 19782.1 ⁵⁸	9.69	-	
Tape	Truck / 962 ⁵⁹	14.4	-	(Fakt, 2014)
	Van / 49.3 ⁶⁰	0.737	-	
	Ship / 18971.1 ⁶¹	284	-	
Water	Tap water distribution system	-	-	-

Consumable	Means of transportation / Distance [km]	tkm/FU	Modeled with	Reference
Epoxy	Truck / 965.5 ⁶²	236	*Transport, lorry 16-32t, EURO3/RER U	(Bodotex, 2013b)
	Van / 49.3 ⁶³	12.1	*Transport, van <3.5t/RER U	
F-Liner	Coating: Truck / 1774 ⁶⁴	64.9	-	(Larsen, 2013)
	Van / 49.3 ⁶⁵	1.8	-	
	Felt: Truck / 1325 ⁶⁶	124	-	
	Van / 49.3 ⁶⁷	4.62	-	
	Ship / 590 ⁶⁸	55.3	Container ship ocean, technology mix, 27.500 dwt pay load capacity RER S	
Cure	Truck / 1926.5 ⁶⁹	227	-	(Bodotex, 2013a)
	Van / 49.3 ⁷⁰	5.8	-	

⁵⁰ From Sonnenbühl, Germany trough Säffle, Sweden to Aarsleff Rörteknik Rotebro.

⁵¹ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁵² From Aarsleff A/S, Denmark to Aarsleff Rörteknik Rotebro (no manufacturer found, neglected).

⁵³ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁵⁴ From Aarsleff A/S, Denmark to Aarsleff Rörteknik Rotebro (no manufacturer found, neglected).

⁵⁵ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁵⁶ From harbor in Denmark to Stokvistapes in Norrköping to Aarsleff Rörteknik Rotebro.

⁵⁷ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁵⁸ From factory in New Taipei City, Taiwan to harbor in Denmark.

⁵⁹ From harbor in Denmark to Stokvistapes in Norrköping to Aarsleff Rörteknik Rotebro.

⁶⁰ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁶¹ From factory in China to harbor in Denmark.

⁶² From Boxotex Composites factory in Denmark to Aarsleff A/S, Denmark to Aarsleff Rörteknik Rotebro.

⁶³ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁶⁴ From Icopal factory, Netherlands to Aarsleff A/S to Aarsleff Rörteknik Rotebro.

⁶⁵ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁶⁶ From Cosmotec factory, England to Immingham Harbor plus Esbjerg Harbor, Denmark to Aarsleff A/S, Denmark to Aarsleff Rörteknik Rotebro.

⁶⁷ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

⁶⁸ From Immingham Harbor, England to Esbjerg Harbor, Denmark.

⁶⁹ From Boxotex Composites factory in Denmark to Aarsleff A/S, Denmark to Aarsleff Rörteknik Rotebro.

⁷⁰ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

Pipe replacement inventory

Consumables

Consumable	Content	Reference value	Weight [kg]/F U	Modeled with	References
EPS ⁷¹	Byggcement CEM 11 Cement 90-95 % Expanderad polystyrene EPS 5-10 %	15 cm/m ² floor bathroom	6309.7 512	*Portland cement, strength class Z 42.5, at plant/CH U *Expandable polystyrene (EPS) E	(Binett and Wange nborg, 2014)
Fix ⁷²	Portland cement/sand	0.2 kg/m ² floor/walls bathroom	2053.2	Cement, unspecified, at plant/CH U	(Binett and Wange nborg, 2014)
Gloves: Ninja ⁷³	Nylon Polyurethane coating	1 pair/apartment	1.65 0.15	*Nylon 66 granulate (PA 66), production mix, at plant RER *PUR, rigid foam, at plant/RER U	(Binett and Wange nborg, 2014)
Grout ⁷⁴	Cement Dolomite Sand	0.5 kg/m ² floor/walls bathroom	380.2	Cement, unspecified, at plant/CH U	(Binett and Wange nborg, 2014)
Paint ⁷⁵	INOVA GRUNDA+ INOVA TAK	6.5m ² /liter 5 m ² /liter Per m ² ceiling	49.2	Alkyd paint, white, 60% in H ₂ O, at plant/RER U	(Binett and Wange nborg, 2014)
Plaster ⁷⁶	Weber Gypsum Naturgips	1.5 cm / m ² wall-area	16800	Gypsum plaster (CaSO ₄ beta hemihydrates) DE S	(Binett and Wange nborg, 2014)
Plasterboard ⁷⁷	Norgips Normal 13x900x2700MM	1 unit/apartment	696	Gypsum plaster board, at plant/CH U	(Binett and Wange nborg, 2014)

⁷¹ Product information sheet regarding EPSCement EC350M [Online]. http://www.combimix.se/pdf/Combimix_EPSCementEC350M_PDB_SV.pdf [Accessed 24 January 2014].

⁷² Product information sheet regarding Weber Set Basic [Online]. http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_set_basic.pdf [Accessed 29 January 2014].

⁷³ Ninjagloves comparison chart including product specifications on Ninja Flex gloves. http://www.ninjagloves.com/docs/Comp_chart.html.

⁷⁴ Product information sheet regarding Weber color 800 [Online]. http://www.weber.se/uploads/tx_weberproductpage/weber.color800kakelfog_datasheet.pdf [Accessed 29 January 2014].

⁷⁵ Product information sheet regarding Inova Grund & Inova Tak [Online]. http://www.nordsjo.se/wp-content/uploads/wpsc/downloadables/Inova_Tak_tds_se.pdf & http://www.nordsjo.se/wp-content/uploads/wpsc/downloadables/Original_Grundfarg_vagg_och_tak_tds_se.pdf [Accessed 3 March 2014].

⁷⁶ Product information sheet regarding Weber gypsum naturgips [Online]. http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_gypsum_naturgips.pdf [Accessed 10 March 2014].

⁷⁷ Product information sheet regarding Norgips Normal 13 [Online]. <http://www.norgips.se/getres/index1,427.htm/56a96f4d058b12f0b6ae620eb885b710b12de47b.pdf> [Accessed 10 March 2014].

Primer⁷⁸	Weber Tec.1	0.2 kg/m ² walls, floor, and ceiling bathroom	180	Polyvinylchloride resin (E-PVC), emulsion polymerization, production mix, at plant RER	(Binett and Wange nborg, 2014)
Protective cardboard⁷⁹	Paper	233.3 m / house	44.1	White-lined chipboard, WLC, at plant/RER U	Estimate
Protective plastic⁸⁰	Polyethylene film	Covering 4 doors per apartment	36.1	Polyethylene, LLDPE, granulate, at plant/RER U	Estimate
Patching material⁸¹	Cement	30 kg / apartment	870	Cement, unspecified, at plant/CH U	(Binett and Wange nborg, 2014)
Screed⁸²	Quartz sand Dolomite Portland cement Aluminate cement Gypsum PVAC sampolymer	3 cm/m ² floor bathroom	3380 1500 376 1130 751 376	Silica sand, at plant/DE U Dolomite, at plant/RER U Portland cement, strength class Z 52.5, at plant/CH U Cement, unspecified, at plant/CH U Gypsum, mineral, at mine/CH U Vinyl acetate, at plant/RER U	(Binett and Wange nborg, 2014)
Tape⁸³	PVC film Rubber	727.6 m/ house	7.05 0.371	PVC calendered sheet E Synthetic rubber, at plant/RER U	Estimate
Tiles⁸⁴	Centro 20x20 cm Tiles "square"	12 kg /m ² wall and flooring	9125.5	Ceramic tiles, at regional storage/CH U	(Binett and Wange nborg, 2014)
Water	Tap water	Mixing for all material + 5 % cleaning tools	7040	Tap water, at user/RER U	Estimate
Water proofing⁸⁵	Weber tec 2	1 kg/m ² bathroom walls, floor and ceiling.	899.6	Acrylonitrile-butadiene-styrene copolymer, ABS, at plant/RER U	(Binett and Wange nborg, 2014)

⁷⁸ Product information sheet regarding Weber Tec 1 [Online].

http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_tec_1_tatskiktsprimer.pdf [Accessed 10 March 2014].

⁷⁹ Personal communication with Grunda AB: Product information regarding production and delivery routes of cotton cloths and protective cardboard.

⁸⁰ Technical information regarding K-3 bag/Plastic cover manufactured by Trioplast [Online]. <http://trioplast.com/product-catalog/products/>. [Accessed 20 November 2013.]

⁸¹ Product information sheet regarding Weber Anl ggningscement [Online]. http://www.weber.se/uploads/tx_weberproductpage/e4f750808e924ca5befd305c973f75b3.pdf [Accessed 10 March 2014].

⁸² Product information sheet regarding Weber Floor Rapid 4360 [Online]. http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_floor_4360_base_flow_ra pid.pdf [Accessed 10 March 2014].

⁸³ Personal communication with Ann Fakt. Electrical tape RHE 15 product information from Stokvistapes AB.

⁸⁴ Personal communication with sales department on Centro Kakel och Klinker AB

⁸⁵ Product information sheet regarding Weber Tec 2 [Online]. http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_tec_2_tatskiktsmembran.pdf [Accessed 10 March 2014].

Pipe replacement inventory

Consumables

Consumable	Content	Reference value	Weight [kg]/FU	Modeled with	References
EPS ⁸⁶	Byggcement CEM 11 Cement 90–95%	15 cm/m ² floor bathroom	6309.7	*Portland cement, strength class Z 42.5, at plant/CH U	(Binett and Wangenborg, 2014)
	Expanderad polystyrene EPS 5–10%		512	*Expandable polystyrene (EPS) E	
Fix ⁸⁷	Portland cement/sand	0.2 kg/m ² floor/walls bathroom	2053.2	Cement, unspecified, at plant/CH U	(Binett and Wangenborg, 2014)
Gloves: Ninja ⁸⁸	Nylon	1 pair/apartment	1.65	*Nylon 66 granulate (PA 66), production mix, at plant RER	(Binett and Wangenborg, 2014)
	Polyurethane coating		0.15	*PUR, rigid foam, at plant/RER U	
Grout ⁸⁹	Cement Dolomite Sand	0.5 kg/m ² floor/walls bathroom	380.2	Cement, unspecified, at plant/CH U	(Binett and Wangenborg, 2014)
Paint ⁹⁰	INOVA GRUNDA+ INOVA TAK	6.5m ² /liter 5 m ² /liter Per m ² ceiling	49.2	Alkyd paint, white, 60% in H ₂ O, at plant/RER U	(Binett and Wangenborg, 2014)
Plaster ⁹¹	Weber Gypsum Naturgips	1.5 cm/m ² wall-area	16800	Gypsum plaster (CaSO ₄ beta hemihydrates) DE S	(Binett and Wangenborg, 2014)
Plasterboard ⁹²	Norgips Normal 13x900x2700MM	1 unit/apartment	696	Gypsum plaster board, at plant/CH U	(Binett and Wangenborg, 2014)
Primer ⁹³	Weber Tec.1	0.2 kg/m ² walls, floor, and ceiling bathroom	180	Polyvinylchloride resin (E-PVC), emulsion polymerization, production mix, at plant RER	(Binett and Wangenborg, 2014)

⁸⁶ Product information sheet regarding EPSCement EC350M [Online]. http://www.combimix.se/pdf/Combimix_EPSCementEC350M_PDB_SV.pdf [Accessed 24 January 2014].

⁸⁷ Product information sheet regarding Weber Set Basic [Online]. http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_set_basic.pdf [Accessed 29 January 2014].

⁸⁸ Ninjagloves comparison chart including product specifications on Ninja Flex gloves. http://www.ninjaloves.com/docs/Comp_chart.html.

⁸⁹ Product information sheet regarding Weber color 800 [Online]. http://www.weber.se/uploads/tx_weberproductpage/weber.color800kakelfog_datasheet.pdf [Accessed 29 January 2014].

⁹⁰ Product information sheet regarding Inova Grund & Inova Tak [Online]. http://www.nordsjo.se/wp-content/uploads/wpsc/downloadables/Inova_Tak_tds_se.pdf & http://www.nordsjo.se/wp-content/uploads/wpsc/downloadables/Original_Grundfarg_vagg_och_tak_tds.se.pdf [Accessed 3 March 2014].

⁹¹ Product information sheet regarding Weber gypsum naturgips [Online]. http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_gypsum_naturgips.pdf [Accessed 10 March 2014].

⁹² Product information sheet regarding Norgips Normal 13 [Online]. <http://www.norgips.se/getres/index1,427.htm/56a96f4d058b12f0b6ae620eb885b710b12de47b.pdf> [Accessed 10 March 2014].

⁹³ Product information sheet regarding Weber Tec 1 [Online]. http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_tec_1_tatskitksprimer.pdf [Accessed 10 March 2014].

Protective cardboard ⁹⁴	Paper	233.3 m/house	44.1	White-lined chipboard, WLC, at plant/RER U	Estimate
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Protective cardboard ⁹⁵	Paper	233.3 m/house	44.1	White-lined chipboard, WLC, at plant/RER U	Estimate
Protective plastic ⁹⁶	Polyethylene film	Covering 4 doors per apartment	36.1	Polyethylene, LLDPE, granulate, at plant/RER U	Estimate
Patching material ⁹⁷	Cement	30 kg/apartment	870	Cement, unspecified, at plant/CH U	(Binett and Wangenborg, 2014)
Screed ⁹⁸	Quartz sand	3 cm/m ² floor bathroom	3380	Silica sand, at plant/DE U Dolomite, at plant/RER U Portland cement, strength class Z 52.5, at plant/CH U Cement, unspecified, at plant/CH U Gypsum, mineral, at mine/CH U Vinyl acetate, at plant/RER U	(Binett and Wangenborg, 2014)
	Dolomite		1500		
	Portland cement		376		
	Aluminate cement		1130		
	Gypsum PVAC sampolymer		751 376		
Tape ⁹⁹	PVC film	727.6 m/house	7.05	PVC calendered sheet E Synthetic rubber, at plant/RER U	Estimate
	Rubber		0.371		
Tiles ¹⁰⁰	Centro 20x20 cm Tiles "square"	12 kg/m ² wall and flooring	9125.5	Ceramic tiles, at regional storage/CH U	(Binett and Wangenborg, 2014)
Water	Tap water	Mixing for all material + 5% cleaning tools	7040	Tap water, at user/RER U	Estimate
Water proofing ¹⁰¹	Weber tec 2	1 kg/m ² bathroom walls, floor, and ceiling.	899.6	Acrylonitrile-butadiene-styrene copolymer, ABS, at plant/RER U	(Binett and Wangenborg, 2014)

Piping

Consumable	Content	Reference value	Weight [kg]/FU	Modeled with	References
PVC ¹⁰²	PVC pipes	123 m 100 Ø 70.5 m 75 Ø	349	PVC pipe E	(Aarsl eff,

⁹⁴ Personal communication with Grunda AB: *Product information regarding production and delivery routes of cotton cloths and protective cardboard.*

⁹⁵ Personal communication with Grunda AB: *Product information regarding production and delivery routes of cotton cloths and protective cardboard.*

⁹⁶ *Technical information regarding K-3 bag/Plastic cover manufactured by Trioplast [Online].* <http://trioplast.com/product-catalog/products/> [Accessed 20 November 2013].

⁹⁷ *Product information sheet regarding Weber Anläggningcement [Online].* http://www.weber.se/uploads/tx_weberproductpage/e4f750808e924ca5befd305c973f75b3.pdf [Accessed 10 March 2014].

⁹⁸ *Product information sheet regarding Weber Floor Rapid 4360 [Online].* http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_floor_4360_base_flow_rapid.pdf [Accessed 10 March 2014].

⁹⁹ Personal communication with Ann Fakt. *Electrical tape RHE 15 product information from Stokvistapes AB.*

¹⁰⁰ Personal communication with sales department on Centro Kakel och Klinker AB

¹⁰¹ *Product information sheet regarding Weber Tec 2 [Online].* http://www.weber.se/uploads/tx_weberproductpage/printable_sheet_weber_tec_2_tatskitksmembran.pdf [Accessed 10 March 2014].

¹⁰² *Product information regarding PVC pipes from Onninen webshop [Online]* <https://se.onnishop.com/> [Accessed 18 January 2014].

		8.7 m 50 Ø			2013)
MA ¹⁰³	Cast iron pipes	123 m 100 Ø 70.5 m 75 Ø 8.7 m 50 Ø	1480	Cast iron, at plant/RER U	(Aarsl eff, 2013)

Operations

Tool	Reference value	kWh/FU	Modeled with	Reference
Core drill ¹⁰⁴	Hilti DD 200 2.6 kW 0.5 h/apartment	37.7	Electricity, low voltage, production SE, at grid/SE U	(Binett and Wangenberg, 2014)
Cutter machine ¹⁰⁵	DeWalt DW 777 1.8 kW 5 minutes/apartment	4.35	-	(Binett and Wangenberg, 2014)
Dehumidifier ¹⁰⁶	A 60BTB Dehumidifier 640W 14 days per apartment 24h/day	6236.2	-	(Binett and Wangenberg, 2014)
Dust-trap ¹⁰⁷	Pullman Ermator A2000 385 W 8h/apartment	89.3	-	(Binett and Wangenberg, 2014)
Flex ¹⁰⁸	Festool Betonghandslip Renofix RG 130 E Plus 1.6 kW 1h/apartment	46.4	-	(Binett and Wangenberg, 2014)
Industrial vacuum cleaner ¹⁰⁹	KÄRCHER WD 7.500 1.6 kWh 6h/apartment	278	-	(Binett and Wangenberg, 2014)
Jigsaw ¹¹⁰	Milwaukee V 28 Battery 84 Wh 1 battery/apartment	2.5	-	(Binett and Wangenberg, 2014)
Material pump ¹¹¹	Weber Brukspump 5.5 kW 1h/apartment	160	-	(Binett and Wangenberg, 2014)
Mixer ¹¹²	4USE-VT5690 1.6 kWh 1 hour/apartment	46.4	-	(Binett and Wangenberg, 2014)

¹⁰³ Product information regarding MA pipes from Gustavsbergs rör catalog [Online] http://www.gustavsberg-ror.se/backnet/media_archive/original/9e053761c73ac9e85a3d69f01d2b3b77.pdf [Accessed 18 January 2014].

¹⁰⁴ Hilti DD 200 [Online] <https://www.us.hilti.com/diamond-coring-%26-sawing/diamond-drilling-tools/r3081> [Accessed 20 February 2014].

¹⁰⁵ DEWALT. 2014. DW777 [Online] <http://www.dewalt.se/powertools/productdetails/catno/DW777/info/specifications/> [Accessed 20 February 2014].

¹⁰⁶ Product information sheet regarding El-Björn A 60BTB Dehumidifier [Online]. http://www.elbjorn.com/sv/produkter/klimat/byggavfuktare/kondensavfuktare/e8745005_byggavfuktare [Accessed 20 February 2014].

¹⁰⁷ Product information sheet regarding Pullman Ermator A2000 [Online]. http://www.pullman-ermator.se/pdf/manual/manual_a1000-a2000_sv-eng_rev2.pdf [Accessed 21 February 2014].

¹⁰⁸ Renofix RG 130 E Plus Productsheet [Online]. <https://www.festool.se/Produkter/Pages/Product-Detail.aspx?pid=768809&name=Diamantslip-RENOFIX-RG-130-E-Plus> [Accessed 21 February 2014].

¹⁰⁹ Kärcher WD 7.500 Industrial vacuum cleaner productsheet [Online]. <http://www.karcher.se/document/BTA-5325198-000-00.pdf> [Accessed 22 February 2014].

¹¹⁰ M28 Lithium-Ion Battery Pack productsheet [Online]. <http://documents.milwaukeeetool.com/58-97-0500.pdf> [Accessed 25 February 2014].

¹¹¹ Weber technical support telephone support regarding “Weber brukspump”.

¹¹² 4USE-VT5690 Mixer product information [Online]. <http://handla.swedol.se/default.asp?ArtNr=6454512>. [Accessed 26 February 2014].

Plaster machine ¹¹³	PFT G4 XL 7.5 kW 6h/9 apartments	146	-	(Binett and Wangenborg, 2014)
Reciprocating saw ¹¹⁴	Milwaukee 28V HD28SX-32C 2 batteries/apartment	4.9	-	(Binett and Wangenborg, 2014)
Rotary hammer ¹¹⁵	Bosch GSH27 2kW 9h/apartment	522	-	(Binett and Wangenborg, 2014)
Screwdriver ¹¹⁶	Milwaukee V28 Battery 84 Wh ½ battery/apartment	1.2	-	(Binett and Wangenborg, 2014)
Tile saw ¹¹⁷	Husqvarna TS230F 0.8 kW 0.5h/apartment	11.6	-	(Binett and Wangenborg, 2014)
Vacuum suction ¹¹⁸	Disab CENTURION LN200/9-1812 incl. Kaeser Omega 83 PV Diesel engine 242 kW 12h/9 apartment	9333.9	Diesel, burned in diesel-electric generating set/GLO U	(Binett and Wangenborg, 2014)
Consumable	Means of transportation / Distance [km]	tkm/FU	Modeled with	Reference
EPS	Cement: Truck / 579.9 ¹¹⁹	3660	Transport, lorry 16-32t, EURO3/RER U Container ship ocean, technology mix, 27,500 dwt pay load capacity RER S -	(Nordenson, 2014)
	Ship / 932 ¹²⁰	5880		
	EPS: Truck / 1518.4 ¹²¹ Ship / 18.7 ¹²²	777 9.57		
Fix	Truck / 269 ¹²³	552	-	(Nelfelt, 2014a)
Gloves: Ninja	Truck / 529.5 ¹²⁴ Van / 49.3 ¹²⁵	0.953 0.0887	-	(Ninjagloves, 2007)
	Boat / 18193.8 ¹²⁶	32.7	*Transport, van <3.5t/RER U Transport, transoceanic freight ship/OCE U	
Grout	Truck / 269 ¹²⁷	102	-	(Nelfelt, 2014a)

¹¹³ PFT G4 XL Technical information sheet [Online].

http://www.pft.de/www/en/produkte/produktprogramm/mischpumpen/mischpumpe.php?stein_id=878&st=4#open [Accessed 22 February 2014].

¹¹⁴ M28 Lithium-Ion Battery Pack productsheet [Online]. <http://documents.milwaukeeetool.com/58-97-0500.pdf> [Accessed 25 February 2014].

¹¹⁵ Bosch GSH27 Powertool productsheet [Online]. <http://www.bosch-pt.co.in/in/en/professional/power-tools/c131452/p105249/breakers/gsh-27-vc.html> [Accessed 22 February 2014].

¹¹⁶ M28 Lithium-Ion Battery Pack productsheet [Online]. <http://documents.milwaukeeetool.com/58-97-0500.pdf> [Accessed 25 February 2014].

¹¹⁷ Husqvarna TS230F technical specification [Online]. <http://www.husqvarna.com/se/construction/products/masonry-and-tile-saws-product-range/ts-230-f/#specifications> [Accessed 20 February 2014].

¹¹⁸ CENTURION LN200/9-1812 product sheet [Online]. <http://disab.com/wp-content/uploads/2012/02/LN200-9-1812-eng1.pdf> [Accessed 26 February 2014].

¹¹⁹ From factory in Rüdersdorf to Szczecin harbour plus Västerås harbour to Combimix AB to construction site.

¹²⁰ From Szczecin Harbor to Västerås Harbor.

¹²¹ From factory in Netherlands to Combimix AB, Västerås to construction site [road ways].

¹²² From factory in Netherlands to Combimix AB, Västerås to construction site [water ways].

¹²³ From factory in Motala to construction site.

¹²⁴ From Ansell factory in Thailand to harbor in Thailand plus harbor in Göteborg to Aarsleff Rörteknik Rotebro.

¹²⁵ From Aarsleff Rörteknik Rotebro to construction site in Uppsala.

¹²⁶ From Thailand to Göteborg.

Paint	Truck / 674 ¹²⁸ Van / 0.85 ¹²⁹	33.2 0.0418	- -	(Akzo Nobel, 2012)
Plaster	Truck / 52.5 ¹³⁰	881	-	(Nelfelt, 2014b)
Plasterboard	Truck / 180 ¹³¹	365	-	(Norgips, 2014)
Primer	Truck / 269 ¹³²	48.4	-	(Nelfelt, 2014a)
Protective cardboard	Truck / 1223.3 ¹³³	53.9	-	(Grunda, 2014)
Protective plastic	Truck / 267.6 ¹³⁴	9.66	- -	(Ahlseil, 2013)
Patching material	Truck / 70 ¹³⁵	60.9	-	(Nelfelt, 2014a)
Screed	Truck / 52.5 ¹³⁶	394	-	(Nelfelt, 2014a)
Tape	Truck / 1011.3 ¹³⁷ Boat / 18971.1 ¹³⁸	7.5 141	- --	(Fakt, 2014)
Tiles	Truck / 1489.1 ¹³⁹ Ship / 48.9 ¹⁴⁰	13600 446	-	(Åkerman, 2014)
Water	Tap water distribution system	-	-	-
Water proofing	Truck / 269 ¹⁴¹	242	-	(Nelfelt, 2014a)

¹²⁷ From factory in Motala to construction site.

¹²⁸ From factory in Arlöv to Nordsjö Idé och Design, Uppsala.

¹²⁹ From Nordsjö Idé och Design, Uppsala to construction site.

¹³⁰ From factory in Sollentuna to construction site.

¹³¹ From factory in Örebro to construction site.

¹³² From factory in Motala to construction site.

¹³³ From factory (unknown location) to Nordiskt Papper AB in Kungsängen to Grunda AB in Ulricehamn to construction site.

¹³⁴ From Trioplast AB factory to Ahlseil in Sollentuna through Ahlseil logistics central in Hallsberg to construction site.

¹³⁵ From factory in Sala to construction site.

¹³⁶ From factory in Sollentuna to construction site.

¹³⁷ From factory in China to construction site [road ways].

¹³⁸ From factory in China to construction site [water ways].

¹³⁹ From factory in Czech Republic to storage in Järfälla to construction site [road ways]

¹⁴⁰ From factory in Czech Republic to storage in Järfälla to construction site [water ways].

¹⁴¹ From factory in Motala to construction site.

Transport

	Means of transportation / Distance [km]	tkm/FU	Modeled with	Reference
PVC	Truck / 393 ¹⁴²	137	Transport, lorry 16–32t, EURO3/RER U	(PipeLife, 2014)
MA (Cast iron)	Truck / 567 ¹⁴³	838	-	(Gustavsberg Rörsystem AB, 2014)

¹⁴² From factory in Ljung to Onninen storage in Örebro to construction site.

¹⁴³ From factory in Halmstad to construction site.