“How can I in a safe way improve the working environment for welders that work at a temporary workplace?”
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RESEARCH
Metal/iron and steelworkers including welders are today seen to have one of the most dangerous professions in the world. Even so there’s a huge amount of people out there working with this type of profession. Only in Sweden we have between 16 000 - 20 000 with the title welder and an even greater amount that has a different title but a lot of welding involved in their work. Car mechanics is a good example for this. The number here lays around 150-200 000 people according to svets.se (Svetskommisionen) and svetsarätt.se.

There’s a lot of different types of welding you can work with. Some are involved with robotic welding and some with manual. Within the manual welding there is also a lot of different working types. For example you can work inside at a fixed workplace or out on the field where the environment and conditions varies from day to day. In their case the equipment needs to be lightweighted, and easy to carry, as portable as possible. If not the welder can’t bring it and sometimes they have to skip a good equipment that in other cases would have protected them. Within these working area there’s not to uncommon to work in weird or extreme ergonomic positions that strains your body.

According to svets.se (Svetskommisionen) not a lot has happened in the field of manuel welding for a long time when it comes to the development of equipment. This you can clearly see if you are to compare with the progress of robotic welding for example. According to ESAB their Design office at in Gothenberg has only existed for 6 years now. They started up in 2010. The first company to start an inhouse department within this area though was Kemppi and they did it by 2001. So this area is still pretty new and unexplored if you compare to a lot of other professions that have had more time to work on and develop their products and equipments.
DESIGN PROBLEM

A welder’s working environment is overall very tough and contains a lot of different problem areas. One of the biggest problems there is today are the toxic fumes. Recently the substance manganese has been discovered to be one of the worst components within the welding fumes according to svetsarätt.se. According to Arbetsmiljöverket the toxic fumes is the main source for a lot of diseases. Such as pulmonary edema, asthma, chronic bronchitis, COPD, pneumonia and a lot of different heart diseases. As a welder you have a 40% greater risk of developing cancer compared to other professions. These diseases are only to mention a few of what you could get as a welder.

But there is more. As a welder you also handle a great amount of high voltage every day which could be very dangerous, a lot higher if you compare to other professions. Also as a result of the high voltage there’s a byproduct from the voltage and high amperage combined which is strong magnetic fields that could be problematic. The regulations related to magnetic fields are getting tighter. This profession is also exposed to both UV, IR, visible light radiation and air pollution caused by the dust and particles and not the fumes. Because of this they’re at high risk of eye injuries, skin damage is also very common within this working area, mainly because of the strong UV radiation. This often leads to severe burns and in worst case skin cancer. Ear damage is also something to watch out for, especially if you work at a temporary working place with a bad position. For example if you lay down and weld the welding sparks will easily find its way into your ears and damage them. This often shows by impaired balance and vertigo, this also according to Arbetsmiljöverket.

Welding is also seen as an extremely physically demanding profession, according to statistics from Arbetsmiljöverket, a total of 63% of all welders are thoroughly exhausted in their bodies after a week of work. Pain in the shoulders, arms, hips, knees, feet and lower back are very common.

Now imagine that you’re a welder that works out on the field, a temporary working place. In their case, all working conditions becomes even more difficult and less predictable. For them to protect themselves from all these problems, diseases and damages is a lot more complicated. To add to this is also that as welder out on the field you don’t have a fixed workplace and rarely have access to a good working position.
The goal with my project is to improve the working environment for the welder that works at a temporary working place. I want to create a safer environment and make the welding work in a smoother way. I want to improve the ergonomics aspects and create a better workflow.

With this project I want to apply new technologies and materials that can be helpful for the development of the welding industry.

I want to get people to open their eyes to this problem. Especially the equipment manufacturers and the economics that are behind products like this and are the ones that can make them exist. I also want to demonstrate that development must take place within this profession. This because welding is seen as one of the most dangerous professions on earth today.

Welding is also a profession that are unlikely to subside for the future, it will rather be the other way around. This is because it’s considered to be an incredibly productive and cost effective way to assemble metals with each other, with both wear resistant and durable results. The growth of welding are likely to increase as the growth of infrastructure gets higher.
COLLABORATION

My collaboration for this project has been ESAB and their Inhouse Design office that is located in Gothenburg in Sweden.

ESAB is one of the world’s leading manufacturer of equipment and consumables for welding and cutting. Their solutions are well known throughout the world for its innovativeness.

They have acted as a source of information and expertise within the welding area and as a guide in the evaluation of concepts. They have also been sponsoring the whole project.

I also have a second hand partner. This is FUMEX. They have provide me with technical support.

DELIMITATIONS

Since the welding profession is very wide I’ve decided to limit myself to the welders within the temporary working place area. This because I’ve seen a lot of problems within this area and also that it has great potential for development within this field.

Because the short amount of time I also limited myself to three users that I will dive deeper into. As a compliment to this I will also send out a survey for a bigger amount of users to answer, this to get a some what broader response.

TARGET GROUP

Companies that work out on the field at temporary working places, in my case it has been smaller welding companies places in Umeå.
TIMEPLAN/DESIGN PROCESS

V.8-9
- Collecting facts
- Fieldtrips/Interviews
- Talks with collaboration partner

V.9-10
- Summarize fieldtrips/interviews
- Summarize talks with collaboration partner

V.10-12
- Ideation (sketching, mockups)
- Workshop
- New technologies/materials
- Revisit collaboration partner/user

V.13-14
- Sketching
- Form development
- CAD
- Color/trim/details

V.14-16
- Model making (Priming)
- Visualisations
- Prepare presentation
- Finish report
My main users are three smaller welding/mechanic companies in Umeå that does a little bit of everything when it comes to welding. This includes welding jobs out on the field with a lot of different environments and conditions involved.

I’ve got to observe, interview and follow these three companies. They have helped me within my research phase, to find my main problems, but also later on in my evaluation phase, to help me move on with a concept and to improve it.
I've been out on two field studies for this purpose. Once at a building site to watch the people from Umesvets do some welding and the second time at Ziggma Industriservice AB to observe the people there. This to see two very common but different environments within the field of welding at a temporary working place.

I could easily detect there where very different problems that occurred. At the building site most of the problems related to the clothing. They easily got worn out, wet, cold or too warm. Other main problems related to bad welding positions and bad ergonomics, which led to a lot of physical pain. Mainly in the knees, shoulders and back. This since the most common welding positions were either sitting down on the knees or with the arms above head height.

At the other workplace we were located inside at a lumber mill. Since this was the case the weather wasn’t much of a problem, but instead the ventilation was a big problem. They welded in painted metals which gave away even worse fumes to inhale. Even though this was the case they didn’t bring any extractors with them. The smaller fume extractor they thought to be very bad with too low capacity and the bigger “portable” one to be too big and unwieldy. They only brought an extractor with them if they were to weld at a really confined space.

They told me that even though the toxic fumes are a huge problem not too many welders do actually complain about this fact, not until it is too late. This because it doesn’t really show until years later. The toxic fumes a welder often has to inhale does in the long run lead to a lot of various diseases (as mentioned under Design problems) in worst case an early death. The welders told different stories about relatives to them that have died early due to heart and lung diseases and they thought it had to be connected to the welding since they worked with it for years.
QUALITATIVE INTERVIEWS

I had some qualitative interviews with my users. From these interviews I got to know some more information about the main problems. I tried to interview some different people that had worked with welding for a different duration of time. This was very important to me and my research. By doing this it became clear that the people that had worked within this field for a longer time saw different problems than the people that worked for a shorter time.

The biggest difference was that a welder that had worked for approximately 30 years could tell me a lot about the difference from then to now when it comes to the welding equipment and welding development in general.

I got to know that the area within manual welding that have had the most progress was the one close to the welder, such as clothing and the helmet. The helmet is today much lighter, Speedglas helps protect the eyes and helps the vision. The clothing lasts much longer and has some flame protection today, though it wears out after a while. The ergonomic problems has also been looked into a bit. Today you can for example protect your knees with kneepads. But when it comes to the area of ventilation, fume and portable extractors not a lot has happened at all, especially not the “portable” ones. They look about the same as they have always done. This all of the welders thought to be a big problem since they are highly needed for the sake of the welders health in the long run.

The people I got to interview also talked a lot about the potential and development opportunities within this area, so they thought it would be a good thing for me to look more into this area and try to design a new solution to help their situation.

Other problems they told me about was mostly related to bad ergonomics and bad clothing. This due to a lot of bad welding positions, mainly on the knees and with arms above head height. The clothing was mainly a problem outside due too hard weather conditions. Everyone seemed to be overall very happy with the helmet and the small portable stud welders so that was an area they thought I could let go for this project.

In the end I tried to ask them what area they thought was most important/dangerous according to the different welding zones. Some of them said Zone 1 (This is the zone that are closest to the welder. Including: torch/welding gun, visitor/helmet, respirator, protection wear, e.g.) but almost all of them said Zone 3 and 4 (This is the zones that are furthest away from the welder. Including: power source, start and end action, setting occurs seldom, power cable, log software, equipment startup, e.g.) But that was if ventilations and extractors would be included there as well. I also asked them to choose between me trying to solve the ergonomic problems or the problems with the toxic fumes. To that question I got a clear answer, the issue about the toxic fumes was more important to them. Especially when they have to work out on the field, because then they often skip that sort of equipment since it’s either too big, inefficient or has too low capacity.
ANALYZE
MAIN PROBLEMS

Toxic fumes are the biggest issue out on the field. A lot of times ergonomic problems is something you can fix yourself with a little imagination, but there's nothing you can do about the dangerous welding fumes, you need good equipment for that!

When welding outside the weather conditions becomes a big problem. Either it's too warm or too cold. Since you sit still a lot it becomes even colder. The clothes doesn't stand all weather conditions too well.

Mobility, portability and accessability is a big must out on the field, but a lot of times that's not solved too well which becomes a big problem. These problems often occur with the extractors. The ones that actually has enough of capacity to do a good work are too big/unwieldy and are barely used because of that.

Ergonomic problems are one of the biggest issues out there. While welding at a temporary working place you often have to weld in bad/weird positions which strains the body a lot. The most common position are either sitting down on your knees welding or with your arms above head height.
After my research phase it was very clear that the biggest problem for the welders at a temporary workplace was the ergonomic problems and protection from the highly toxic fumes.

I made the choice to continue working with the toxic fumes. I made this choice based on the information I had collected during my user studies and interviews. The users was pointing a lot towards this problem and they also pointed out that it was the root of a lot of later on problems and diseases, that it put a best before date on the welders. I also chose this area since it according to the users had a lot of potential to develop further, especially within the field of welding at temporary working places.

After years of welding the welders often develop a lot of different heart diseases.

The lungs are also highly affected because of the fumes. As a welder you have a 40% bigger risk of getting cancer compared to other professions.
With my research one thing I’ve come to understand is the great importance of mobility and accessibility within this specific area of welding.

When you’re a welder at a temporary workplace you move around a lot, the environment always looks different and your conditions vary from time to time. Whether you find yourself out on a building site or inside a confined space there are some important things that are in common.

The working environment for the welder out on the field is often very stressful so the equipment you use needs to be easy to access all the time. When you’re working side by side with many other professions, which you do most of the time, there are tight time schedules that has to be followed. When this is the case there is no time to just go away to get some equipment, even if it’s a fume/portable extractor or something else that helps with the welders health. It has to be there on spot ready to be used whenever needed. Because of this all of the equipments needs to be as small and lightweighted as possible. It must also be flexible and easy to move around. This applies to both going to and from the working place, but also when you’re at the spot working. Since this is such a big importance all of the equipment must fit well together and work as a whole while transported but also work well by itself in various situations and working environments.

If this doesn’t work well it doesn’t matter how much the equipment helps the welders health or how high capacity it has. If it’s not mobile and easy to access it won’t be used. This is what happens a lot of times with todays portable extractors. They do their job with extracting toxic fumes very well but they’re simply too large and unwieldy for anyone to ever use them out on the field.
Today there are four different products that are used to protect the welder/environment from toxic fumes.

Aside from the big/unwieldy portable fume extractor there are some smaller fume extractors that are much more lightweighted and mobile, but when it comes to those they don’t have enough capacity to do a good job and actually help the welder. Then there is also welding helmets with air filters. The thing about those are that it makes the helmet even heavier and bigger than it already is which strains the neck a lot. It also doesn’t take away the fumes it just cleans the air you breathe in. This affects the welders vision a lot which affects their work. Lastly there are integrated extractions for welding nozzles. This equipment works very well since it takes away the fumes right away and very close to the source. But this equipment are only used in workshops, never out on the field. This since they are too heavy/unwieldy and since they work together with a mig/mag weld, not a stick weld which are used when working at a temporary working place.

With this information and from the users own words the way to go is probably something in between the larger portable extractor and the smaller fume extractor. This because a mixture of them would according to the welder be very optimal for the type of work they do.
- Mobile units are not aloud to weight more than 20 kg.

- Minimum size of these filters: External dimensions - 300x200 mm / Interior dimensions - 200 x 120 mm. (BOX) ED - 380x200mm / ID - 280x120 mm. (CYLINDER) (Ändra)

- The cylinder shape saves space in width, which is preferable!

- To take up welding sparks / coarse dust cyclone filters are good - But they are extremely heavy.

- The best method is to let the suction go from the outside in.

- Other solution to take up welding sparks/coarse dust is with a metal filter/ spark trap (then you need to let the suction go from the inside out instead) - These can be found in hoods/hollow exhaust pipes for example.

- All filters are pleated (A must!)

- Maximum gone deep for the filters - 50 mm.

- Felt mat - a must for sound isolation. 25-30 mm benefit is needed for this.

- For extra sound isolation you can add a lead carpet/asphalt carpet - As needed 5 extra mm to spare. This makes it however makes it larger and heavier.

- Todays extractors are made in steel/aluminum. Steel is cheaper/more durable and heat resistant!

- Other good material that are used is polyurethane (PUR) - Very cheap/heat resistant, but not so impact resistant. (Available in engine compartments including)

- Injection molded polypropylene with 30% glass = very good both designwise (You can mold better shapes, combine two materials. It's also very durable/robust and heat resistant. 4-5 mm thick.

- Ebm-papst. a company that makes EC motors. Very good and sustainable/ environmentally friendly. (For my product, check R3G 200)

- Todays extraction is a little back-loaded due to the engine. The emphasis is on 40-60 %. Hence, the product has a long handle so you can lift further back for better balance and easier lifting.

- Air outlets at the back. Needs to be at least 10 holes with minimum 23 mm space in between. Each hole should have an diameter on 10 mm. This to make a better airflow which makes the product as quite as it can be.

TECHNICAL FACTS

- MF (Small fume extractor) - 1000 m3/h / 42 liter/s
- SF (Bigger portable extractor) - 150 m3/h / 28 liter/s

- The smaller extractor the closer to the fume source you need to get.

- If the extraction nozzle is 1 dm away nothing happens! It needs o be even closer for an effect.

- An elongated cylindrical extraction nozzle is preffered by the user, more efficient than a full round.

- On the portable filters carbon brush engines (vacuum cleaner motors) instead of fans. Fans are far too heavy, a fan can weigh around 25 kg!

- Keeping the motor within the filter as in MF 150 saves a lot of space.

- Bigger carbon filters are needed for higher capacity.

- Contact time (through the carbon filter) 0.2 s - minimum, 0.4 - recomended. 0.6 - Excellent. 1 s - Optimally. The longer time the bigger the filter need to be!

- MF (Small fume extractor) weights around 12-20 kg today.

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IDEATION/REFINEMENT
WORKSHOP

I held a workshop at the school with some different people to get some new fresh ideas and perspectives on how to solve different problems that accured to me during my research and analyzing phase.

I hade four questions that I asked and they got 10 minutes on each, 5 minutes for sketching/writing down there ideas 5 for some discussion afterwards. I got some pretty good ideas from all of them.

1. To transport the equipments in a easier/smooother way, a lot of them suggested to combine the weld with the extractor so it would become one unit. This is something that I’ve thought about briefly as one of my three concepts so it was very good to also hear other people thinking of it. If not combined they thought of some trolley, back-pack or carrige to bring it all with you in an easy way. Some of them also mentioned that it could be transported with a drone or some sort of caterpillar robot that followed the welder.

2. To change the filter in a smooth way a lot of them suggested that you could have a bunch of filter in at once, and when you pull out a used one another new one folds out. This to speed up the whole process and to make the big change of filters that takes more time not as often. If there was a possibility to clean the filters they thought of having them cleaned in the extractor itself, then press out the waste in a compact form.

3. When it came to how to come as close to the source of the fumes as possible they had some different suggestion. Some thougt of applying the hose to the welder clothes, for example the gloves, some thougt it could be on the weld or at the part that your welding on. To get a better extraction some also thought of having more than one hose or making it wider to double the capacity.

4. Lastly I asked them about how to “show” important information/values for the welder while they’re working. For example the oxygen levels in the room or information about the filter, when to change it and so on. They all talked a lot about haptic feedback, with colors, light and sound. Maybe some vibrations in the clothing or welding nozzle to tell the welders when they need to stop or take a break. They also thought a screen would be good as a visual compliment, either in the helmet or on the weld/extractor. Symbols that are easy to read they thougt was a good idea and just numbers and very small amount of text. It should be very clear and easy to understand, not too complicated.
BRAND BOARD

BLACK&YELLOW

CHAMFERS

HERITAGE

HONEST

INTERACTIVE DETAILS

RELIABLE
CMF BOARD

ROUGH SURFACES

BRIGHT YELLOW ACCENT COLORS

MATERIAL/COLOUR MEETINGS

MATTE/GLOSSY
CONCEPT 1

Handles for each unit. Pushed down while not in use and pulled up for carriage.

Handle for the filter in the back. Just push this handle to make the filter come out, this makes it easy and fast to change.

The trolley can be dragged or pushed, whatever you prefer.

This solution contains two separate units (The stud weld + new extractor) and a smart smaller trolley. The trolley can be pushed or dragged and the angle of it can be adjusted, this to make the travel to the workplace as easy and smooth as possible. The trolley has a magnetic base so the units can be put on there to stay in an easy and fast way. Also other metal things like tools can be put on there as well if thats what the user want to do.
CONCEPT 2

- Pushed down while not in use and pulled up for carriage.

There is two wheels on the back of the extractor unit, this so it can be used as a trolley while put together as one unit.

The hose/ cables are to be hanged on the sides of units. This to be held in place and to not be in the way while not in use.

This is a combined unit/equipment of a stick weld and the new extractor. It can either be used as one piece, easily rolled around with one handle and two wheels or separately used as two units. While in single mode they can easily be carried around since they have their own handles for that purpose. This makes the equipment easy to bring with you to the workplace but also very easy to carry around at the workplace, no matter what it looks like. It makes the travel smoother and the accessibility and mobility higher and more convenient for the welder that works at a temporary workplace.

The hose/ cables are to be hanged on the sides of units. This to be held in place and to not be in the way while not in use.

The handle on the weld unit can be adjusted. This to minimize space while not in use. If you want to use it, just push it and it will come out by itself.

To switch the filter of the extractor unit is very easy. Just like the handle of the combined unit it’s just to push it to make it come out.

The handle on the weld unit can be adjusted. This to minimize space while not in use. If you want to use it, just push it and it will come out by itself.

The usage of the handle is for when it’s used as one unit, it then becomes like a trolley.
USER EVALUATION

I went to Umesvets for some user evaluation, unfortunately the guys at Allmek & Svets had a lot to do so didn’t have time to meet. I talked to Joe whom I’ve interviewed before to see what he thought of my concepts and which one he would like me continue with and to develop further.

Design wise he really liked the second concept but due to the functions he went with the first one. This mainly because it was more modular and allows for bigger freedom, which is preferable for welders out on the field. Since your working environment varies a lot from time to time you often need to bring different stuff with you. For example; toolboxes, grinders, ear protectors, helmets etc. You want to be able to put it all on the trolley, not just the stick weld and extractor. He really liked the thought of making the trolley as small as possible while not in use. He also came with some valuable suggestions regarding the trolley. One was that it could have some sort of hooks attached, so everything could be lifted easily by a crane while needed to make the mobility even higher. He also thought it could be even more modular, that some extra baseplane could be pulled out to make room for more equipments while needed. He told me that it was better to have a long and narrow trolley than a wide and thick, since you often need to get it through narrow spaces. When the trolley was just standing he thought it would be good to have some protection on its base so the handle wouldn’t hit the ground. The idea of having an adjustable angle of the handle he thought to be unnecessary, better for it to be fixed in a good angle from the beginning. The idea of having the base of the trolley and the units to be magnetic to stick better he also thought to be bad. This because a lot of metal shavings and particles would stick there as well. Instead he thought it would be better to have a boarder along the base but to keep it open inside so the user can throw on whatever the work situation requires.

“The first concept is very good since it allows for more modularity and freedom when it comes to what you bring with you to the workplace”

Joe - Umesvets
CONCEPT 1

Handles for each unit.
- Pushed down while not in use and pulled up for carriage.

The handle on the trolley can also be adjusted. This to minimize space while not in use.

The trolley's base is magnetic, so are the units. This too save time and make it easy to always bring the units with you. You can take them on and off in a fast and smooth way.

The trolley can be dragged or pushed, whatever you prefer.

This solution contains two separate units. The usable to weldings and extractors are trolleys. The whee are and

Concept 1 is designed for the right of a car that is to blend in with the workplace area and make it easy to handle. The trolley has an ergonomic shape and can be adjusted. It makes it easy to carry and keep the unit in mind. The trolley can easily be driven on and off the workplace.

CONCEPT 2

This is a combined unit / equipment of a stud weld + new extractor. It can either be used as one piece, easily rolled around with one handle and two wheels or separately as an extractor. While in single mode it can be turned around and have its own tool kit to store the earring of the cable. The trolley is designed to be carried with two wheels to the workplace. The unit can be easily transported with the help of the trolley to the workplace. The unit can be easily stored in a compact way with the help of the trolley in a compact way.

To switch the filter of the extractor unit is very easy. Just like the handle of the combined unit you just push it to make it come out.

The hose/cables are to be hung on the sides of the units. This to be held in place and to not be in the way while not in use.

CHOSEN CONCEPT

The first concept was chosen because of its modularity. When you're working out on the field you never know what the situation will look like and what is required. You always have to bring the weld in this new scenario also the extractor. But a lot of times you're not only bringing that. You need toolboxes, ear protections, helmets, grinders etc. It was preferrer to then have a separate trolley that you could put anything you needed on and the just fold while not in use to take up less space. To keep in mind from the second concept is to still think of a solution which collects the hose in a good way.
I made a rough mockup, scale 1:1.

This too understand the actual size and the proportions better. Also to see how much space all the inside components would take up and where they should be placed within my form. After I did this I got a feeling of how big my final product would be and that it would match the users requirements for size.
FORM SKETCHING

I explored some basic shape and color to find a direction that was matching both the brandboard of ESAB that I’ve made but also my own formboard.

After that I explored some details, like the handle, opening for the filter, outlet for air and the bottom base/feet (to give this round product some balance while standing on the ground.)
Final Concept

The Fume Extractor

- Feet: Four pairs of feet for good balance. It's able to stand on more bumpy ground. Chamfered to keep the ESAB heritage.
- Cord: Due to the extractor's cylindrical shape, the cord storage is located inside. Just like a vacuum cleaner, you just press a button to make it roll up, and you drag it out by hand.
- Cover: Protective part, injection molded polypropylene with 30% glass. Durable/Robust/Heat resistant. It's black, since ESAB uses this color for parts that will wear and tear lot. The octagon shape emphasizes the yellow color and logo, it's also gives a very iconic shape.
- Drum: Stainless steel. Durable/Sound isolation/Heat resistant. Yellow coating to make the product and the logo stand out.
- Magnetic part: To attach to the extraction nozzle while welding.
- Screen and buttons: Screen to show information about the filter. Buttons to navigate/on/off.
- Nozzle: Injection molded polypropylene with 30% glass. Durable/Robust/Heat resistant.
- Big rubber band: To wrap around the hose to collect it. Either carry the hose or put it on the extractor.
- Steel hose joint: Can be adjusted to get the nozzle in the right angle.
- Steel hose part: Can be adjusted to get the nozzle in the right angle.
- Magnetic part: To attach the extraction nozzle while welding.
- The handle: Long due to the fact that the product is back-loaded. Rounded edges for good ergonomics. Chamfers to follow the brand language. Injection molded polypropylene with 30% glass. Durable/Robust/Heat resistant.
- The hoses: PVC hose. It also contains metal spirals inside to be able to stand the suction. Stretchable PVC part at the end, which makes the hose stay on to the extractor.
Handle
- Has chamfers to show the heritage.
- The length can be adjusted.
- While not in use you push in the handle to take up less space.

Loops
- So that the trolley can be hooked onto a lift.
- Yellow since they are to interact with.

Logotype
- On yellow background at the front of the trolley.

Wheels
- Two big wheels at the back which make it easier to roll over bumps.
- Yellow detail at the inside.

Bumpers
- Two bumpers on each side at the front.
- Works as a support while the trolley is not in use.

Side boarders
- When trolley is in use they are folded up.
- When not in use they are folded down to save space.

NOT IN USE IN USE
I did my CAD model in Rhinoceros.

At this stage I followed my renders as a start but then tried out some different stuff to develop the design a bit further. I integrated the handle more in the form which gave it a nicer look as a whole. I also change the shape for the filter taps. Went from a rounder shape to a one with more chamfers which matched the rest of the product in a better way. In this stage I also redesignes the outlet holes since got new information of how big they should be to optimize the function of the product.
PART 4: WELDING

For the nozzle I mixed parts that I’ve made myself and parts from an already existing nozzle. Since it was in metal that you could bend and adjust I needed to fix it so that it couldn’t be bent once the paint was on. If someone were to bend it with paint on it would probably crack the paint and make the final model ugly. Therefore I did some spot welding inside the metal pipe to fix it before priming and painting it.

PART 5: SANDING

After all of this there was a lot of sanding going on to make the surfaces nice and smooth after all the gluing and puttying.
PART 6: PRIMING

The next step was priming the model parts. I used two different kind of primers. For the grey PU foam I used a 2K filler since it covers up the pores in this material way better than the 1K filler. This is not needed for the red PU foam since it has a higher density so for that one I used a 1K primer. After this I did some more sanding to make the surfaces super smooth and ready for the final painting.

PART 7: PAINTING

The final stage was to put on the final paint and to assembly all the parts. I used different textures for the different parts and surfaces. The protective parts got to be black with a rougher surface and some of them black matte. The interactive part I painted in yellow. The parts you’re suppose to get in touch with got a matte surface and the other parts a semi glossy yellow color to get it to imitate the yellow coating that ESABS products have today.
The last thing I needed to do was putting all pieces together with some glue and putty to get some nice split lines. I also put on some decals with logos and smaller symbols to make the final touch. After that I took it out to see the sun for a little photo session. Next up is the UID'16 Designtalks and exhibition, 5th-6th of June!
THE CONCEPT
**THE FUME EXTRACTOR**

- **Nozzle**
  - A flat nozzle to get as much of the fumes as possible.
  - Magnetic part to get the nozzle as close to the fume source as possible.

- **Top handle**
  - Long due to the extractor being backloaded, making it easier to handle.
  - Injection molded polypropylene with 30% glass (Durable/Robust/Heat resistant).
  - One harder material and one softer for a better grip.

- **Protection cover**
  - Protects the steel drum.
  - Injection molded polypropylene with 30% glass (Durable/Robust/Heat resistant).
  - Black and rough bumpy texture.

- **Filter tap**
  - Twists and turns to open, easy and fast way to change the filters.
  - One filter tap on each side for each filter.

- **The hose**
  - Made of PVC plastic.
  - Contains metal spirals to withstand suction.
  - Stretchable PVC parts at the ends, to connect it to the body and nozzle.

- **The pipe**
  - Bendable, to get as close to the fume source as possible.

- **Air outlet**
  - Holes with a minimum of 23 mm space in between and a diameter of 10 mm each.
  - This makes the airflow more quiet which makes this product more quite.

- **Filter tap**
  - Twist and turn function to open, easy and fast way to change the filters.
  - One filter tap on each side for each filter.

- **Air outlets**
  - Holes with a minimum of 23 mm space in between and a diameter of 10 mm each.
  - This makes the airflow more quite which makes this product more quite.

- **Protection cover**
  - Injection molded polypropylene with 30% glass (Durable/Robust/Heat resistant).
  - Semi matte black finish.

- **Outlet**
  - Cable management on the inside.

- **Screen and buttons**
  - Screen to show filter information.
  - Small buttons to navigate in the systems and to turn on/off the extractor and screen.
  - Big button to roll up the cable.

- **The feet**
  - Four feet to give the product a good balance even on uneven/bumpy grounds.

- **The drum**
  - Stainless steel with yellow coating.
  - Made of PVC plastic.
  - Contains metal spirals to withstand suction.
  - Stretchable PVC parts at the ends, to connect it to the body and nozzle.

- **Protective chamfers**
  - Injection molded polypropylene with 30% glass (Durable/Robust/Heat resistant).
  - Semi matte black finish.

- **The logotype**
  - Black coated logo onto the yellow stainless steel drum.
  - The black protection cover emphasizes the logo.
INSIDE COMPONENTS

**Spark trap**
- Collects sparks, smaller metal parts, and dust.
- Measurements: 50 mm thickness. This way the product can’t catch on fire!

**Particle filter**
- Basic filter that is needed for all extractors.
- A pleated filter with a gone deep of 25 mm (maximum is 50 mm)
- Measurements:
  - Outside diameter: 260 mm
  - Length: 220 mm

**Motor**
- The motor lies within the particle filter.
- Takes up less space and for gives a very good sound isolation, makes the product more quiet.
- Measurements:
  - Outside diameter: 145 mm
  - Length: 150 mm

**Cable management**
- Goes around the filters with a good protection.
- Takes up less space when it inside of the product.
- Makes the product more efficient to bring and use.

**Electronics**
- A small space for the electronics.
- Also goes around the filters with a good protection.
- Electronics is often put between the filters for these type of products.

**Carbon filter**
- A bigger filter that makes the whole difference for this product!
  - This filter takes up the toxic fumes that comes from the welding.
  - Contact time through the filter:
    - 0.2 s - minimum, 0.4 s - recommended, 0.6 s - Excellent, 1 s - optimally.
  - This product has a contact time of 0.67 s, which is over excellent. Almost as good as the biggest “portable” fume extractors on the market today! they weight between 67-69 kg. This new product will weight about 12-15 kg!
- Measurements:
  - Outside diameter: 360 mm
  - Length: 240 mm

**Course filter**
- G4 filter, (A rougher filter)
- Makes the air that comes out in the end even more clean and not as black and thick.
- Measurements: 20 mm thickness.
THE INTERFACE

A simple and self-explanatory interface with information about when to change the filters. A gradient from green to red shows in smaller steps on how close to a full filter you are, this so that the welder will know when to change them in time so that they can plan it better and make the work more efficient.

Buttons are used since this is a very hard and tough working environment which touch doesn’t do well in. They are also wearing gloves almost all the time, therefore a reduced number of buttons are the best choice.
THE TROLLEY

Handle
- Adjustable/collapsible

Supports
- Support underneath at the front of the trolley while standing and not in use

Loops
- 2 loops to attach to a lift while needed

Wheels
- Big wheels at the back to give a better balance while rolling the trolley

- When the trolley is not in use, it can easily be folded together to take up as little space as possible
Extractor
- The new portable extractor with high capacity got to determine the length of the trolley. You won’t need to bring anything bigger than that.
- The length of the extractor: 687 mm
- The length of the trolley: 701 mm

Stick weld
- The very small and dainty pinnsvetsen can just place next to the extractor. These two represent the width of the trolley.
- The width of the extraction + stick weld: 512 mm
- The width of the trolley: 520 mm

Tool box
- The remaining space is for other things that may be necessary to include at the workplace.
- When you work at a temporary workplace the needs are constantly changing and so are the tools that you need to bring along.
- A toolbox is something that often gets to come along.

Grinder
- The remaining space is for other things that may be necessary to include at the workplace.
- When you work at a temporary workplace the needs are constantly changing and so are the tools that you need to bring along.
- A grinder is often good to have since this profession rarely only includes welding.
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