RECP Best Practice Catalogue

Ducted fresh air intake for air compressor

Developed within the framework of MED TEST II

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

switchmed

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SECTOR:	**Food & Beverage**
SUBSECTOR:	Bakery and farinaceous products
PRODUCTS	Bread, cakes, muffins, Arabic sweets, petit-four, kaak, ice cream
CATEGORY	Good Housekeeping
APPLICABILITY	Utilities

COMPANY NAME	NOT DISCLOSED
COMPANY SIZE	SME

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Description of the problem (Base scenario):

Compressed air is extensively used in this bakery to operate machines. The demand for compressed air is continuous around the clock because the bakery operates 24 hours all year long. The rotary air compressors respectively of 37KW, 22KW and 15KW capacity are located in a shed made up of walls on three sides and one fence link on the fourth side. The roof of the shed which is made up of corrugated fiberglass sheets is exposed to the sun for an extended period of time during summer. The shed itself is in a narrow alley where other machinery is located, also the chimney of an Arabic bread oven is located across the alley and radiates much heat.

The compressors themselves, which are crowded in this shed, are the source of much heat generated from their cooling radiators, this compounds the problem because the hot air exhausted from the compressors radiators is sucked into the compressors process air intakes.

The result is that the average intake air temperature may be at 12°C above ambient in summer and around 7°C in winter. Air compressors performance is much affected by intake air temperature, their electricity consumption is practically a linear function of intake air temperature. As a rule of thumb, in case a compressor operates for more than 5,000 hours a year at 80% full capacity, each 1.5°C rise in intake air temperature will result in an electricity consumption increases of around 1%.

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Description of the solution	It is proposed to install a duct on the intake of 37 KW air compressor routed upwards outside the shed so compressors draw ambient air which is much cooler than the air in the shed (See figure 1 below). The duct will have following characteristics: - Minimum pressure drop in ducts - Ducts made of galvanized steel 18 gage with proper bracing and supports - Duct coated with fiberglass blanket insulation with FSK jacket to minimize heat gain - Duct to have easily removable filter drawer - Insect screen on the intake - Intake opening position to avoid rain ingress and avoid Venturi effect negative pressures By doing so the average air intake temperature will drop around 10°C over the year. If the rule of thumb is applied then electricity consumption should drop by around 6.6%. In the context of the information system campaign undertaken at the early stages of the project in May 2016, an electricity meter was installed in the main panel feeding the air compressors and a run hour counter was installed on each air compressor. After one year of readings, solid and reliable data was obtained to calculate energy savings. It appeared from the readings that most of the load was covered by the 37 KW compressor which operated 5,681 hours, the 22 KW compressor having operated only 6 hours and the 15 KW compressor 681 hours. The overall electrical consumption for the three compressors amounted to 87.2 MWhr/year. Calculations show that the share of the 37 KW compressor is around 75 MWhr.

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Description of the solution

The following formula is applied to calculate energy savings for the 37 KW compressor

Where $\Delta KWhr = \frac{W*LF*HR*(Tie - Tir)}{\eta*Tie}$ (ref. provided in remark)

- ΔKWhr: Electrical energy savings from implementation
- W: Compressor electrical rating = 37 KW
- LF: Compressor load factor estimated at 85%
- HR: Operating hours per year = 5,681
- H: Efficiency of electric motor = 85%
- Tie: Average air intake temperature before improvement = 273 + 18 + 10 = 301°K
- Tir: average air intake temperature after improvement = 273 + 18 = 293 °K

Where 18°C is the average yearly ambient temperature of the area where the plant is located,

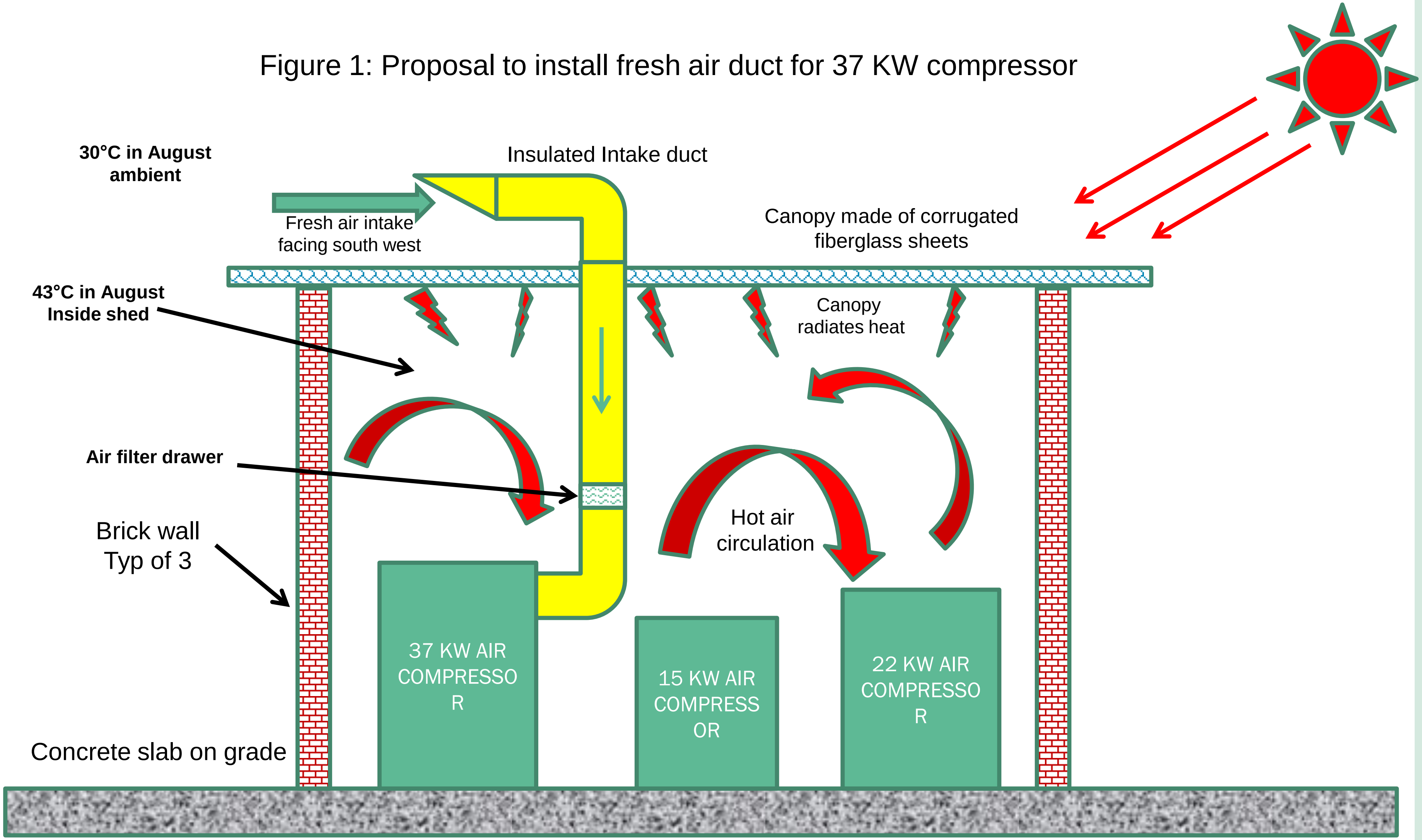
10°C is the average air intake temperature drop over the year after the intervention.

273 being the factor that converts °C to °K

$$\Delta KWhr = \frac{37*0.85*5681*(301 - 293)}{0.85*301} = 5{,}586 \text{ KWhr}$$ (this number is not very far from the rule of thumb)

The financial feasibility will be focused on the 37 KW compressor only as it seems this is the main operating compressor.

Figure 1: Proposal to install fresh air duct for 37 KW compressor



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Economic Benefits	Calculated electricity savings for 37 KW air compressor after intervention: 5,600 Kwhre/year Calculated electricity consumption of 37 KW compressor before intervention: 75,000 Kwhre/year Calculated percentage savings for 37 KW compressor after intervention: 5,600/75,000 = 7% Cost of grid electricity: 0.140 EUR/Kwhre Expected savings after improvement: 5,600*0.140 = 780 EUR/year
Environmental Benefits	Specific CO2 emissions of electricity : 1kg CO_2/Kwhre Avoided CO_2 emissions after implementation: 5,600*1 = 5,600 kg CO_2/year Avoided CO_2 emissions in percentage: 7%
Health and safety impact	Not applicable

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Capital investments & financial indicators	Cost of intervention: EUR 400 Return on investment (simple payback): 0.5 year
Suppliers	Not applicable, no special equipment required.
Other aspects	- An information system was installed by the company at the start of the project at the request of the MED TEST II team. An electricity meter was installed on the main panel feeding the compressors and an hour counter was installed for each compressor. Readings were taken on daily basis. - Above calculations are based on data from July 2016 till June 2017.
Implementation	Measure has been retained by company for final study, implementation not expected before 2019.