**Recommendation ${REC} - Draw Compressor Intake Air from Outside**

### Recommended Action

Use ducting to bring outside air to the intake of the ${HP} HP air compressor package.

### Summary of Estimated Savings and Implementation Costs

|  |  |
| --- | --- |
| Annual Cost Savings | ${ACS} |
| Implementation Cost | ${IC} |
| Payback Period | ${PB} |
| Annual Electricity Savings | ${ES} kWh |
| Annual Demand Savings | ${DS} kW |
| ARC Number | 2.4221.2 |

### Current Practice and Observations

Currently, this plant uses a ${HP} HP air compressor package, which uses indoor air as the intake. This air is warmer than the year-round average outdoor temperature for this location. Warmer air requires more energy to compress than colder air, so energy savings can be realized by ducting in this outdoor air and using it as compressor intake.

### Anticipated Savings

A compressor does less work to compress colder air. The compressor work reduction, CWR, can be written in terms of temperature as follows:

CWR = (TI - TO) / (TI + 460 oF),

where

TI = Average indoor temperature: ${TI}oF

TO = Average daily outdoor temperature during heating season (Oct - May): ${TO}oF[[1]](#footnote-1)

CWR = (${TI}oF - ${TO}oF) / (${TI}oF + 460oF)

= ${CWR}%

The power reduction, PR, from compressor work reduction is given by the following equation:

PR = HP × C1 × FR × CWR / η

where,

HP = Compressor rating: ${HP} HP

C1 = Conversion constant: 0.746 kW/HP

FR = Compressor Power Fraction: ${FR}%

η = Estimated efficiency of compressor: ${ETA}%

PR = ${HP} HP × 0.746 kW/HP × ${FR}% × ${CWR}% / ${ETA}%

= ${PR} kW

The annual energy savings ES equals to:

ES = PR × OH

where,

OH = Operating hours during heating season: ${OH} hrs/yr (${HR} hours per day, ${DY} days per week, ${WK} weeks per year)

ES = ${PR} kW × ${OH} hrs/yr

= ${ES} kWh/yr

The reduced energy usage will also result in a lower demand charge. The demand savings, DS, is as follows:

DS = PR × CF × C2

where

CF = Coincidence factor, probability that the equipment contributes to the kW: ${CF}%/month

C2 = Conversion constant: ${C2} months during heating season per year

DS = ${PR} kW × ${CF}%/mo × ${C2} mos/yr

= ${DS} kW/yr.

The annual cost savings, ACS, is

ACS = ES × Electricity Cost + DS × Demand Cost

= ${ES} kWh/yr × ${EC}/kWh + ${DS} kW/yr × ${DC}/kW

= ${ECS}/yr + ${DCS}/yr

= ${ACS}/yr.

**Implementation Cost**

The implementation cost includes the cost of material and installation of ductwork and a damper. The cost of materials, ductwork, dampers, and installation is estimated to be ${IC}. Ductwork must be provided from the intake of the compressor to the outside of the plant. The damper should remain open when the outside temperature is lower than the temperature near the compressors and should be closed during summer when outside air is relatively warmer than the air in the plant.

It is recommended that during any contact with vendors for the implementation of this recommendation, any effects of moisture content of the outside air on the compressor be taken into account. During colder months, outside air is dryer, but during the summer months that may not be true. Additionally, a control system should be implemented such that the outdoor damper is closed if the ambient air is below freezing as that can damage the compressor.

**The annual electricity savings and demand savings for this recommendation is ${ES} kWh and ${DS} kW, respectively. The annual cost savings is ${ACS} and, with an implementation cost of about ${IC}, the payback period will be ${PB}.**

**Implementation Cost References**

The below links are for implementation cost references. We do not endorse/recommend these brands or products. Furthermore, these products may or may not be suitable for the application. The client should contact a vendor(s) to conduct a detailed study of the process, in order to determine the best product for the recommended application.

* <https://www.lowes.com/pd/IMPERIAL-3-25-in-x-10-in-x-36-in-Galvanized-Steel-Stack-Duct/3130037>
* <https://www.lowes.com/pd/Broan-6-in-Dia-Galvanized-Steel-Powered/3482873>
* <https://www.homedepot.com/p/Master-Flow-14-in-x-8-in-x-4-ft-Half-Section-Rectangular-Duct-RD14X8X48/100159140>

1. [Weather Data (Meteostat)](https://meteostat.net/en/) [↑](#footnote-ref-1)