PGC1000 vs. Classic gas chromatographs
Cost-savings comparison

The PGC1000 is a compact gas chromatograph (GC) which measures C1 through C9+, inert gases and H2S in hydrocarbon processing streams. The PGC1000 needs no shelter, no instrument air and requires reduced maintenance and troubleshooting. This document quantifies many of the capital and operational PGC1000 cost-savings when compared to using a classic GC. A 15-year GC product life is assumed in the analysis for select examples.

A quantifiable cost-savings comparison of gas chromatographs

By Vernadine Merrick, ABB Upstream Products
PGC1000 Cost-savings summary

Introduction

As manufacturing demands increase, regulation tightens and analytical human resources become harder to secure, the need to find viable solutions to plant analytical challenges are intensified.

The purpose of this document is to encourage PGC1000 plant use when operationally feasible in order to maximize operational efficiency and profitability over the product life of the GC. GC product life is expected to be 15 years. A summary of PGC1000 cost-savings are evaluated below.

PGC1000 Cost-savings comparison evaluated

- GC unit cost
- Shelter (including engineering, installation and HVAC utility costs)
- Shipping/transportation (domestic & international)
- Training
- Carrier gas usage
- Cal blend (calibration) gas usage
- Instrument air
- Power consumption
- Maintenance schedule and service rates
- Spare parts

PGC1000 Intangible benefits

The PGC1000 also provides significant intangible operational benefits. These intangible benefits offer customers value through convenience, flexibility, enhanced quality and time-savings. They include:

- Reduced spare parts inventory management.
- Labor flexibility, increasing the number of analyzers a tech supports with simpler training, servicing & troubleshooting.
- A reduced GC footprint for greater plant design alternatives.
- Mitigated environmental impact with the solar power option.
- Pre-defined (repeated) and pre-tested PGC1000 applications, providing consistent performance from unit to unit.
- Standardized and cost-effective sample handling systems four options). Custom sample handling systems are still much lower.

PGC1000 Early startup revenue impact

During a Greenfield plant GC startup and commissioning period, because the PGC1000 does not require a shelter, the customer can be operating two weeks sooner than with a classic GC. It takes 3 weeks on average to install and commission a classic GC. The PGC1000 takes one week or less to install and commission. This translates into 2 weeks of added revenue during the first year. For an 800,000 tons/yr. new ethylene plant, two weeks of additional operation can mean $34.9 million in ethylene product. Existing plant revenue is considerably less, but is still impacted by greater efficiency.

It should be noted, while the PGC1000 offers process customers enormous operational savings, the application scope is more limited than classic GCs. This is many times due to the PGC1000’s operating range of 0° to 131°F. To expand the operating environment beyond this, a Sun Shade would be needed for higher temperatures and an environment enclosure for colder temperatures (down to -40°F). Both solutions add approximately $4,500 per PGC1000 unit.
PGC1000 cost-savings (capital and operational) when compared to a classic gas chromatograph (GC)

A classic GC is one where valves, detectors and ovens are separate, instrument air is required, and a shelter is needed.

In addition, there is an expected plant revenue generation the first year. This is derived from 2 additional weeks of product due to earlier GC startup. For a Greenfield 800,000 ton ethylene plant, it equates to generating $34.9 million more revenue in year one. One could expect more limited revenue gain from an existing operation. However, a 10% efficiency gain is $3.5 million. See summarized chart (below).

### Capital cost-savings

**Parameter** | **6 PGC1000 Cost-savings**
---|---
6 GC units & shelter | $412,300
Transportation to China | $6,684
Training (2 persons) | $12,400
**Total savings** | **$431,384**

### Operational cost-savings

**Parameter** | **Annual PGC1000 Cost-savings for 6 units**
---|---
Shelter HVAC utility | $8,400
Carrier gas usage | $21,000
Cal gas usage | $19,380
Instrument air | $9,461
Power consumption | $2,064
Maintenance | $50,400
Spare parts | -$(759)
**Total savings** | **$109,946**

In addition, there is an expected plant revenue generation the first year. This is derived from 2 additional weeks of product due to earlier GC startup. For a Greenfield 800,000 ton ethylene plant, it equates to generating $34.9 million more revenue in year one. One could expect more limited revenue gain from an existing operation. However, a 10% efficiency gain is $3.5 million. See summarized chart (below).

**PGC1000 Early startup financial impact for Greenfield plants**

800,000 ton/yr. = 725,748 metric ton/yr. plant
725,748 ethylene ton/yr. /365 days = 1,988 ethylene ton/day
1,988 ethylene ton/day x $1,252/ethylene ton = $2,489,415/day
2 weeks = 14 days
$2,489,415 x 14 = $34,851,810 ($34.9M) for 2 weeks
Capital equipment costs

The detailed capital equipment costs comparisons for a project which entails 6 classic GCs and 6 PGC1000s, are below. The project size of 6 GCs was selected to reflect the use of a mid-size shelter. Capital costs are the initial (one-time) expenditures to purchase and install a process GC.

**GC unit & shelter costs (Example is for 6 GC units)**

<table>
<thead>
<tr>
<th>Unit costs</th>
<th>Classic GC</th>
<th>PGC1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average unit cost</td>
<td>$50,000 x 6 = $300,000</td>
<td>$20,000 x 6 = $120,000</td>
</tr>
<tr>
<td>Shelter</td>
<td>10’ x 16’ shelter @ $500 sq. ft. = $80,000</td>
<td>$0</td>
</tr>
<tr>
<td>Sample transport</td>
<td>6 x $5000/each GC = $30,000</td>
<td>$0</td>
</tr>
<tr>
<td>Installation &amp; commissioning</td>
<td>$300,000 x 15% = $45,000</td>
<td>$2,500 x 6 = $15,000</td>
</tr>
<tr>
<td>Engineering costs</td>
<td>$300,000 x 15% = $45,000</td>
<td>$0</td>
</tr>
<tr>
<td>Total cost</td>
<td>$560,000</td>
<td>$147,700</td>
</tr>
</tbody>
</table>

**PGC1000 Savings** $412,300

*PGC1000 operating range is 0 to 131°F. To expand the operating environment beyond this, a Sun Shade would be needed for higher temperatures and an environment enclosure for colder temperatures (to -40°F). Both solutions (sun shade and environmental enclosure) would add approximately $4,500 per PGC1000. This would translate into an additional $27,000 for the example above. The PGC1000 solution savings would be reduced from $412,000 to $385,000.

**Transportation costs (Example is for 6 GC units)**

<table>
<thead>
<tr>
<th>Transportation costs</th>
<th>Houston, TX</th>
<th>Beijing, China</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGC1000</td>
<td>6 x $86 = $516</td>
<td>6 x $333 = $1,998</td>
</tr>
<tr>
<td>Classic GC</td>
<td>6 x $644 = $3,864</td>
<td>6 x $1,447 = $8,682</td>
</tr>
<tr>
<td>PGC1000 Savings</td>
<td>$3,348 ($558/unit)</td>
<td>$6,684 ($1,114/unit)</td>
</tr>
</tbody>
</table>

**Training costs**

<table>
<thead>
<tr>
<th>Training*</th>
<th>Classic GC</th>
<th>PGC1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic GC training class (Level 1)</td>
<td>$2,000 per participant</td>
<td>$1,000 per participant</td>
</tr>
<tr>
<td>Advanced GC training class (Level 2)</td>
<td>$2,000 per participant</td>
<td>$1,000 per participant</td>
</tr>
<tr>
<td>Maxum II Analyzer Network</td>
<td>$2,000 per participant</td>
<td>$0</td>
</tr>
<tr>
<td>Maxum MaxBasic Programming</td>
<td>$2,200 per participant</td>
<td>$0</td>
</tr>
<tr>
<td>Total</td>
<td>$8,200 per participant</td>
<td>$2,000 per participant</td>
</tr>
<tr>
<td>PGC1000 Savings</td>
<td>$6,200 per participant</td>
<td>$12,400</td>
</tr>
</tbody>
</table>

Note 09 Unlike most classic GCs, the PGC1000 does not require additional training for networking and software programming. The product is simple enough that these topics are covered in basic and advanced PGC1000 training courses. This results in half the training cost for GC training.
Early startup revenue impact

While many plants focus on product cost and the associated installation, timing of the installation can be equally important. A faster installation can have a significant impact on the bottom-line. For example, a typical ethylene plant produces 725,748 metric tons (800,000 tons) per year. Platt Global Petrochemical Index (PGPI) price for ethylene in November 2012 was $1,252 per metric ton. The chart below shows the financial impact of enabling a plant to analyze and ship ethylene product in 1 week versus 3 weeks (2 weeks earlier).

PGC1000 Early startup financial impact for Greenfield plants

800,000 ton/yr. = 725,748 metric ton/yr. plant
725,748 ethylene metric ton/yr. /365 days/yr. = 1,988 ethylene metric ton/day
1,988 ethylene metric ton/day x $1,252/ethylene metric ton = $2,489,415/day
2 weeks = 14 days
$2,489,415 x 14 = $34,851,810 ($34.9M) for 2 weeks

Note 10

Operational costs

Operational costs are on-going and extend to the life of the product. Most GCs can expect a product life of 15 years. The annual operational costs are multiplied by this amount to obtain the total operational costs over the life of the GC.

Operational costs (Example is for 6 GC units)

<table>
<thead>
<tr>
<th>Annual operating expense</th>
<th>Classic GC</th>
<th>PGC1000</th>
<th>Operating difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shelter HVAC monthly*</td>
<td>$700 x 12 = $8,400</td>
<td>$0</td>
<td>$8,400</td>
</tr>
<tr>
<td>Carrier gas usage**</td>
<td>8 helium bottles (300 size) per GC each year at $500/bottle = $4,000</td>
<td>1 helium bottle (300 size) per GC each year = $500</td>
<td>$21,000</td>
</tr>
<tr>
<td></td>
<td>6 GCs x $4,000 = $24,000</td>
<td>6 GCs x $500 = $3,000</td>
<td>$21,000</td>
</tr>
<tr>
<td>Calibration gas usage</td>
<td>Size 300 cal blend bottle every 4 months at $1,200 per bottle = $3,600/yr. per GC</td>
<td>Size 48 cal blend bottle once a year at $370 per bottle = $370/yr</td>
<td>$19,380</td>
</tr>
<tr>
<td></td>
<td>6 GCs x $3,600 = $21,600</td>
<td>6 GCs x $370 = $2,220</td>
<td>$19,380</td>
</tr>
<tr>
<td>Instrument air*</td>
<td>1,000 scf = 28,317 L</td>
<td>$0.80/28,317 L x 100 L/min = $0.003</td>
<td>$0.003/min x 1440 min/day x 365 days = $1,577 per GC x 6 = $9,461</td>
</tr>
<tr>
<td>Power consumption</td>
<td>GC uses 500 watts @ steady state 0.5 kw x 8760 hr/yr x $0.08kwh = $350 per GC</td>
<td>GC uses 8 watts @ steady state 0.008 kw x 8760 hr/yr x $0.08kwh = $6 per GC</td>
<td>$0</td>
</tr>
<tr>
<td></td>
<td>$350/GC x 6 = $2,100</td>
<td>$6/GC x 6 = $36</td>
<td>$2,064</td>
</tr>
<tr>
<td>Maintenance***</td>
<td>12 service calls x 4 hrs./call = 48 hrs. /yr x $200/hr. = $9,600 yr/GC</td>
<td>4 service calls x 2 hrs./call = 8 hrs. /yr x $150/hr. = $1,200 yr/GC</td>
<td>$50,400</td>
</tr>
<tr>
<td></td>
<td>6 GCs x $9,600 yr/GC = $57,600</td>
<td>6 GCs x $1,000 yr/GC = $7,200</td>
<td>$50,400</td>
</tr>
<tr>
<td>Spare parts</td>
<td>$1,200 x 6 = $7,200</td>
<td>$7,959</td>
<td>$799</td>
</tr>
<tr>
<td>Annual total</td>
<td>$130,361</td>
<td>$20,415</td>
<td>$109,946</td>
</tr>
<tr>
<td>Savings on 15yr. GC product life</td>
<td>15 x $130,361 = $1,96M</td>
<td>15 x $20,415 = $306K</td>
<td>$1.65 M</td>
</tr>
</tbody>
</table>

Note 11
Note 12

10 An existing ethylene plant throughput efficiency improvement of 10% for 2 weeks = $3.5M

11 The shelter HVAC utility bill estimate is provided by a large petrochemical company. Monthly utility costs are $400 - $1,000. A median number of $700/mo. was chosen to reflect a mid-size shelter. “Avoid the Icebag of Hidden Expenses” article notes instrument air is $0.80/1,000 scf. Instrument air requirements should go up for FID and PPD applications.

12 A classic GC helium bottle is expected to be changed out every six weeks. This equates to 8 bottles a year.
Operational costs continued

Maintenance costs

<table>
<thead>
<tr>
<th>Maintenance</th>
<th>Classic GC</th>
<th>PGC1000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance schedule</td>
<td>Monthly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Average time spent servicing unit</td>
<td>4 hours</td>
<td>2 hours</td>
</tr>
<tr>
<td>Service rate</td>
<td>$200/hr</td>
<td>$125/hr</td>
</tr>
</tbody>
</table>

Note 13
Instrument air is needed for air bath heated classic GCs. Cost for instrument air is on average $0.80/1,000 scf. The usage rate falls within the usage rate of the top classic GCs. Example above uses 100 L/min.

Note 14
A monthly maintenance schedule for classic GCs is highly recommended for FID and FPD applications. Conv. monthly TCD maintenance is typically recommended, but is optional. Tech travel expenses for more frequent visits should also be considered.*PGC1000 operating range is 0 to 131°F. To expand the operating environment beyond this, a Sun Shade would be needed for higher temperatures and an environment enclosure for colder temperatures (to -40°F). Both solutions (sun shade and environmental enclosure) would add approximately $4,500 per PGC1000. This would translate into an additional $27,000 for the example above. The PGC1000 solution savings would be reduced from $412,000 to $385,000.

Spare parts
Spare parts costs over the life of the analyzer can be considerable for the classic GCs: Assuming the 6 PGC1000s are the same application, it is recommended to hold $7,959 in spare parts to support one year of service requirements. A customer can expect to incur on average $1,200 annually for spare parts per classic GC. For 6 classic GCs this comes to $7200. For spare parts, the largest cost-savings is the use of simplified PGC1000 spare parts to reduce maintenance downtime and troubleshooting.
References

Shelter square footage cost & GC number housed; Sunshade & environmental enclosure
Bob Cook, ABB Totalflow Chemist (former Siemens Chemist)

Shelter monthly HAVC utility rates
ExxonMobil Chemical, LA

Sample systems & sample transport costs

Engineering & installation costs
“Process gas chromatography: Avoid the iceberg of hidden expenses” by M. Gaura, Emerson Process Management, TX
http://www2.emersonprocess.com/siteadmincenter/pm%20rosemount%20analytical%20documents/gc_article_hydrocarbon_processing_201110.pdf

Transportation costs of PGC1000 and classic GC
Brenda Easter, ABB Transportation Supervisor, Import/Export Control Administrator & Amanda Parsons, Import/Export Coordinator

Early GC startup revenue

Costs and usage rate of calibration gas
Merle Bell, ABB Project Manager and Calvin Henson, ABB Production Manager

Carrier gas costs and usage rates
Richard Oder, ABB Senior Buyer and Michael Roecker, ABB Lead Chemist (formerly with Siemens)

Instrument air usage & costs

Siemens MAXUM II training costs

Maintenance schedule and service rates
Greg Smith, ABB Service Manager and Michael Roecker, ABB Lead Chemist

Spare parts
Greg Smith, ABB Service Manager and Bob Cook, ABB Chemist