



# Reducing Emissions from Pneumatic Devices

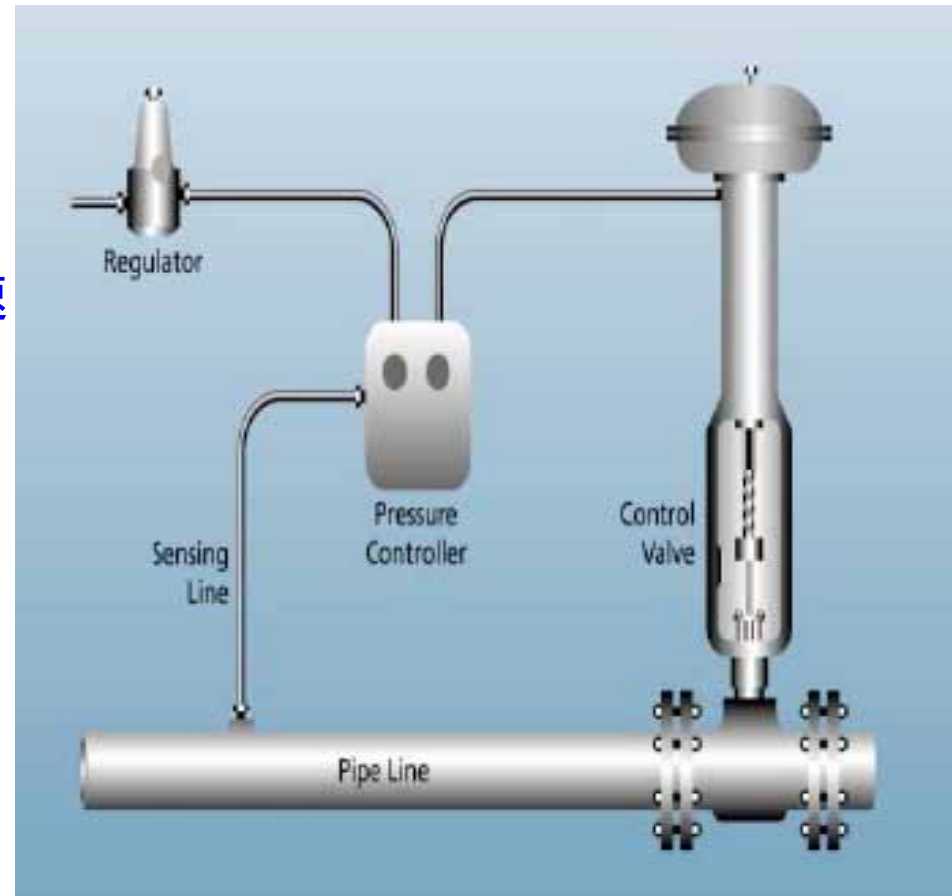
## 减少气动装置排放

**Methane to Markets Partnership  
International Workshop - Oil & Gas  
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# What are Pneumatic Devices?什么是气动装置？

- ▶ Devices that use gas pressure to perform useful work.使用气体压力完成工作的设备
- ▶ Gas consumption rate depends on the device design and settings, and the gas supply pressure.气体消耗速度取决于设备结构和装置以及供气压力
- ▶ Instrument Control Loops:仪表控制回路
- ▶ Chemical Injection Pumps化学剂注入泵
- ▶ Engine Starters发动机起动机
- ▶ Samplers取样器



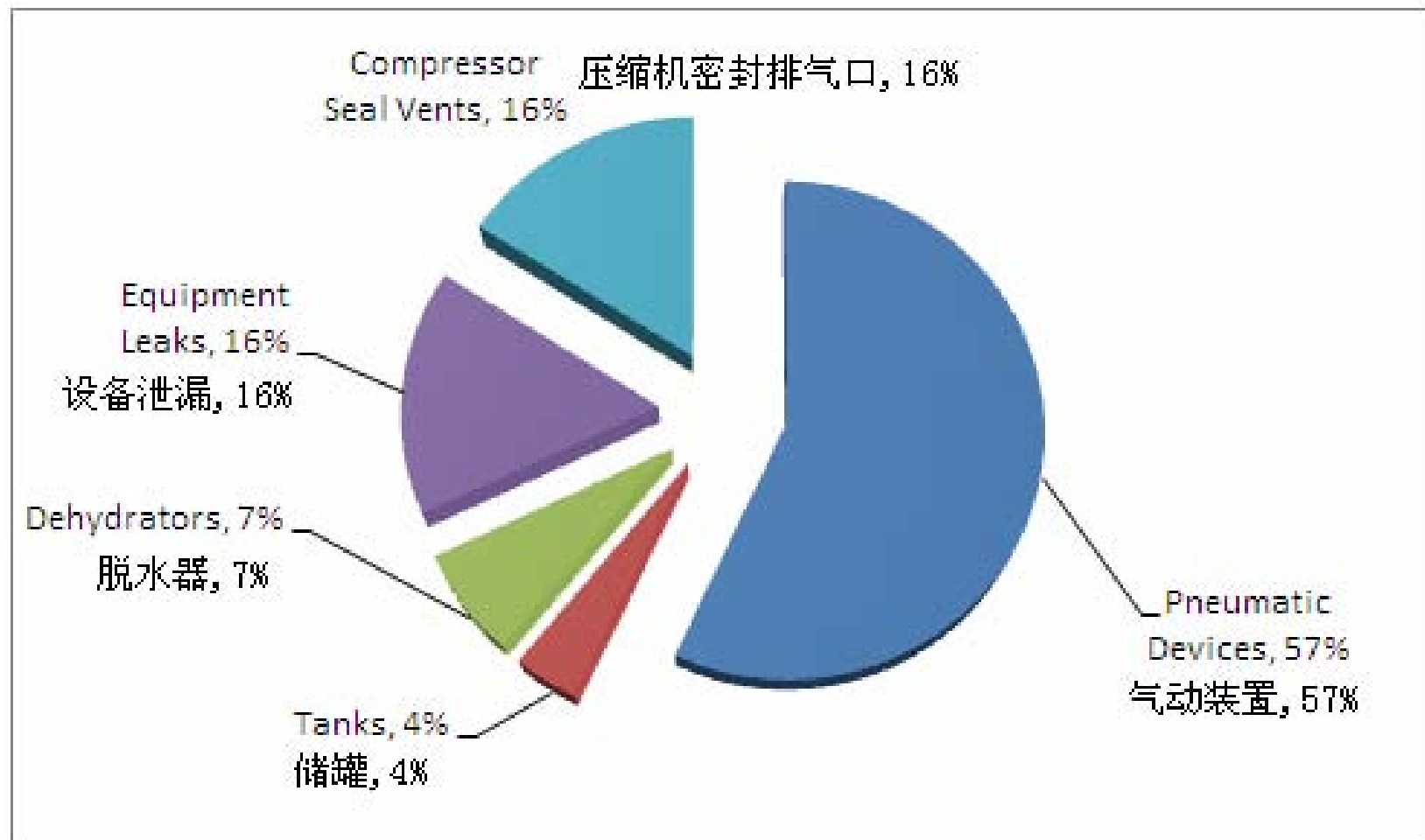
## Where are they used? 气动装置用于何处？

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- Pneumatic devices are widely used at oil and gas production facilities. 气动装置广泛用于油气生产设施中
- A major source of methane emissions where natural gas is used as the supply medium. 天然气用作供气源地方是主要的甲烷排放源
  - Typically smaller or remote facilities where electric power is not available. 特别是在没有电力供应的小型或偏远工厂
- Total gas consumption by pneumatic devices often greater than expected: 气动装置总的耗气量通常远超过预期：
  - Number of sources underestimated. 低估排放源数量
  - Operation of devices not optimized. 设备操作未进行优化
  - Increased gas consumption with wear and tare. 随着磨损加剧，耗气量增加

# Methane Emissions at 76 Gas Production Facilities

## 76个天然气生产厂的甲烷排放情况



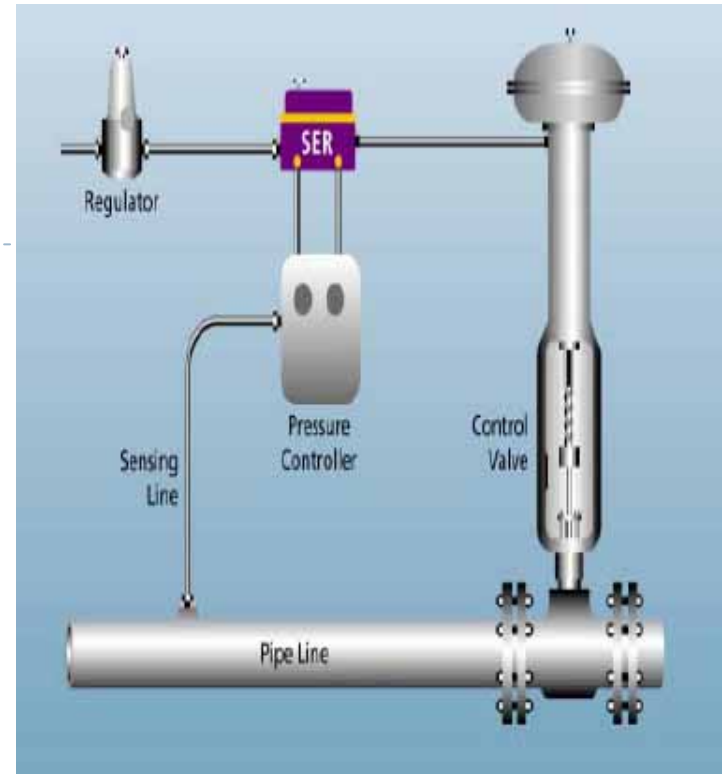
# Solutions 解决方案

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- General 常规做法
  - Convert from natural gas to compressed air. 将天然气转换成仪表风
  - Convert to electric powered devices. 转换成电动装置
  - Install solar powered devices. 安装太阳能装置
  - Capture the vented gas and use as fuel. 收集放空天然气并作燃料用
- Instrument Control Loops: 仪表控制回路
  - Regular maintenance. 定期维护
    - Tune to minimize bleed where process allows. 在工艺许可的情况下将设备调整到最小排量状态
    - Repair worn or faulty controllers. 修理磨损或有故障的控制器
    - Reduce gas supply pressure. 降低供气压力
  - Retrofit with bleed reduction kits (9 month payback). 用减排工具箱对设备进行改装/更新 (9个月收回投资)
  - Replace with mechanical controllers. 更换成机械控制器
  - Replace with low-bleed controllers (6 to 12 month payback). 更换成低排量控制器 (6~12个月收回投资)

# Bleed Reduction System 减排系统

- ▶ Controller requires less pressure to operate than valve actuator. 操作控制器所需压力小于阀门促动器
- ▶ Reduction system reduces gas pressure supplied to the controller (e.g., from 35 psig to 10 psig) but maintains the higher pressure supplied to the valve. 减排系统降低对控制器的供气压力（如从35psig降低到10psig），但对阀门维持较高压力



# Solutions 解决方案

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## ▶ Pumps: 泵

- ▶ Replace with electric pumps. 更换成电动泵
  - ▶ Typically 0.1 kWh of electricity is needed to replace 1 m<sup>3</sup> of gas in these applications. 在这些应用方案中，更换1立方米天然气需要0.1kWh的电力
  - ▶ Affordable pump control systems available for electric pumps to optimize chemical injection programs. 利用可用于电动泵的泵控制系统来优化化学剂注入程序
    - Control based on temperature, pressure, flow and tank liquid level inputs. 基于温度、压力、流量和储罐液位等输入参数来进行控制
    - Reduces chemical consumption. 减少化学剂消耗



# Solutions 解决方案

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## ▶ Engine Starters 发动机起动机

- ▶ Install an air compressor and an adequately sized air receiver. 安装一台空气压缩机和一个大小合适的储气罐
  - ▶ Must be designed to avoid risk of explosion due to oil mist accumulation in the receiver. 由于油雾会在储气罐不断积累，因此必须进行设计以避免爆炸的危险
  - ▶ Can still use process gas as a backup. 仍可将生产废气用作备用气
- ▶ Install electric starters. 安装电动气动机
  - ▶ Usually not done due to penalties for increased peak electric power demand. 由于因增加高峰电力需求而将遭受处罚，通常



## 用氮气启动发动机

Convert Engine Starting to Nitrogen

合作伙伴推荐的甲烷减排机会 (PRO) NO. 101

适  
■  
报

## 用空气启动器代替天然气启动器

Replace Gas Starters with Air

合作伙伴推荐的甲烷减排机会 (PRO) NO. 103

适用领  
■生产  
报道

## 安装电启动器

Install Electric Starters

合作伙伴推荐的甲烷减排机会 (PRO) NO. 108

适用领域:

■生产部门

■处理加工部门

■输气和配气部门

压缩机/发动机 ■

脱水器 □

**天然气驱动的化学泵转变成仪表风驱动的化学泵**

**Convert Gas-Driven Chemical Pumps to Instrument Air**

合作伙伴推荐的甲烷减排机会 (PRO) NO. 202

适用  
■生  
报道

**将气动控制转变成机械控制**

**Convert Pneumatics to Mechanical Controls**

合作伙伴推荐的甲烷减排机会 (PRO) NO. 301

适用  
■生  
报道 I

**变天然气气动控制为仪表风气动控制**

**CONVERT GAS PNEUMATIC CONTROLS TO INSTRUMENT AIR**

[www.epa.gov/gasstar/resources\\_chinese.htm](http://www.epa.gov/gasstar/resources_chinese.htm)

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## 天然气工业中减少气动装置排放甲烷的方案

OPTIONS FOR REDUCING METHANE EMISSIONS  
FROM PNEUMATIC DEVICES IN THE NATURAL GAS INDUSTRY

### 1 内容提要

压缩天然气驱动的气动装置被广泛用在天然气工业中作为液位控制器、压力调节器和阀门控制

# Data for Typical Well-Site Facilities

## 典型井场设施数据

Location	Type	Quantity	Make	Model	Vent Rate (m <sup>3</sup> /h)	Value of Gas (\$/y)	Carbon Credits (\$/y)	Total Potential Value (\$/y)	Comments
Site 1	Pressure	1	Fisher	4150 KR	0.6634	798	1,242	2,040	Compressor building.
	Controllers	1	Fisher	4150 KR	0.104	125	195	320	Compressor building.
		1	Fisher	4150 KR	0.54	649	1,011	1,660	Meter Shack
	Methanol Injection Pumps	2	Texsteam	5100	0.6953	836	1,302	2,138	Meter Shack
	Level Controllers	2	Norriseal	1001	0.4359	524	816	1,340	Meter Shack
	Level Controller	1	Murphy M	L1200N DVO	0.9109	1,095	1,705	2,801	Compressor.
	<b>Total</b>	---	---	---	<b>3.3495</b>	<b>4,028</b>	<b>6,271</b>	<b>10,299</b>	
Site 2	Pressure Controllers	1	Fisher	4150	0.1126	135	211	346	Plunger lift system.
	Level Controller	2	Cemco	2AS-SRD-VF	0.0496	60	93	153	
	Methanol Injection Pump	2	Texsteam	5100	0.501	602	938	1,540	
	<b>Total</b>	---	---	---	<b>0.6632</b>	<b>797</b>	<b>1,242</b>	<b>2,039</b>	
Site 3	Pressure Controllers	1	Fisher	4150 KR	0.0796	96	149	245	Plunger Lift
	Level Controller	2	Norriseal	1001	0.081	97	152	249	
	Methanol Injection Pump	1	CVS	B-548	0.6723	808	1,259	2,067	
	<b>Total</b>	---	---	---	<b>0.8329</b>	<b>1,002</b>	<b>1,559</b>	<b>2,561</b>	
Site 4	Pressure Controllers	1	Dyna-Flo	4000R	1.2744	1,532	2,386	3,918	Choke.
		1	Dyna-Flo	4000	1.0239	1,231	1,917	3,148	Differential pressure controller.
	Level Controllers	2	Norriseal	1001	0.0089	11	17	27	
	Methanol Injection Pumps	1	Bruin	BRX313SP-2511	1.3786	1,658	2,581	4,239	
		1	Bruin	BRX313SP-2511	2.1624	2,600	4,049	6,649	
	<b>Total</b>	---	---	---	<b>5.8482</b>	<b>7,032</b>	<b>10,949</b>	<b>17,982</b>	
Site 5	Pressure Controllers	1	Fisher	4150 CVS Series	0.2998	361	561	922	Equipped with a Serious low-bleed adaptor.
	Level Controllers	2	Fisher	L2	0.0082	10	15	25	
	Methanol Injection Pump	1	Texsteam	MX331ABW02	0.1105	133	207	340	
	<b>Total</b>	---	---	---	<b>0.4185</b>	<b>503</b>	<b>784</b>	<b>1,287</b>	
Site 6	Pressure Controllers	0	---	---	0	0	0	0	
	Level Controllers	2	Fisher	L2	1.0085	1,213	1,888	3,101	
	Methanol Injection Pump	1	Texsteam	MX331ABW02	0.2689	323	503	827	
	<b>Total</b>	---	---	---	<b>1.2774</b>	<b>1,536</b>	<b>2,392</b>	<b>3,928</b>	
Site 7	Level Controllers	2	Fisher	L2	1.0695	1,286	2,002	3,288	
	Methanol Injection Pump	1	Texsteam	MX331ABW02	0.1451	174	272	446	
	<b>Total</b>	---	---	---	<b>1.2146</b>	<b>1,461</b>	<b>2,274</b>	<b>3,735</b>	
<b>All</b>	<b>Average</b>				<b>1.9435</b>	<b>2,337</b>	<b>3,639</b>	<b>5,976</b>	

# Pressure Controllers 压力控制器

Type	Make	Model	Quantity	Emissions (m <sup>3</sup> /h)	Value of Gas (\$/y)	Carbon Credits (\$/y)	Total Potential Value (\$/y)	Comments	
Pressure Controllers	Dyna-Flo	4000R	1	1.2744	1,532	2,386	3,918	Choke.	
		4000	1	1.0239	1,231	1,917	3,148	Differential pressure controller.	
		<b>Average (per controller):</b>			<b>1.1492</b>	<b>1,382</b>	<b>2,152</b>	<b>3,533</b>	
		<b>Manufacturer's Steady State Value</b>			<b>0.11 to 0.72</b>	<b>132 to 866</b>	<b>206 to 1,348</b>	<b>338 to 2,214</b>	<b>For 0 to 100 kPag output range.</b>
					<b>0.19 to 1.1</b>	<b>228 to 1,323</b>	<b>356 to 2,059</b>	<b>584 to 3,382</b>	<b>For 0 to 200 kPag output range.</b>
	Fisher	4150 KR	1	0.6844	823	1,281	2,104	Choke.	
		4150 KR	1	0.6634	798	1,242	2,040	Compressor building.	
		4150 KR	1	0.104	125	195	320	Compressor building.	
		4150 KR	1	0.54	649	1,011	1,660	Meter Shack	
		4150	1	0.1126	135	211	346	Plunger lift system.	
		4150 CVS Series	1	0.2998	361	561	922	Equipped with a Serious low-bleed adaptor.	
		4150 KR	1	0.0796	96	149	245	Plunger Lift	
		<b>Average (per controller):</b>			<b>0.3548</b>	<b>427</b>	<b>664</b>	<b>1,091</b>	
		<b>Manufacturer's Steady State Value</b>			<b>0.0747 to 1.0455</b>	<b>90 to 1,257</b>	<b>140 to 1,957</b>	<b>230 to 3,214</b>	<b>For 20 to 100 kPag output range.</b>
<b>All</b>				<b>0.5313</b>	<b>639</b>	<b>995</b>	<b>1,634</b>		

# Liquid Level Controllers

液位控制器

Type	Make	Model	Quantity	Emissions (m <sup>3</sup> /h)	Value of Gas (\$/y)	Carbon Credits (\$/y)	Total Potential Value (\$/y)	Comments
Level Controller	Cemco	Series 2001NB (2AS-SRD-VF)	2	0.0496	60	93	153	
		<b>Average (per controller):</b>		<b>0.0496</b>	<b>60</b>	<b>93</b>	<b>153</b>	
		<b>Manufacturer's Steady State Value</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>Non-bleed design.</b>
Fisher	L2	2	0.0082	10	15	25	Low-bleed relay.	
	L2	2	1.0085	1,213	1,888	3,101	Low-bleed relay.	
	L2	2	1.0695	1,286	2,002	3,288	Low-bleed relay.	
	<b>Average (per</b>		<b>0.3478</b>	<b>418</b>	<b>651</b>	<b>1,069</b>		
	<b>Manufacturer's Steady State Value</b>		<b>&lt;0.03</b>	<b>&lt;36</b>	<b>&lt;56</b>	<b>&lt;92</b>	<b>Throttling Control</b>	
Murphy Matic	L1200N DVO	1	0.9109	1,095	1,705	2,801	Compressor.	
	<b>Average (per</b>		<b>0.9109</b>	<b>1,095</b>	<b>1,705</b>	<b>2,801</b>		
	<b>Manufacturer's Steady State Value</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>No-bleed Controller.</b>	
Norriseal	1001	2	0.4359	524	816	1,340	Meter Shack	
	1001	2	0.081	97	152	249		
	1001	2	0.0089	11	17	27		
	<b>Average (per</b>		<b>0.0876</b>	<b>105</b>	<b>164</b>	<b>269</b>		
	<b>Manufacturer's Steady State Value</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>No-bleed controller</b>	
<b>All</b>	<b>Average (per</b>		<b>0.2382</b>	<b>286</b>	<b>446</b>	<b>732</b>		

# Chemical Injection Pumps 化学注入泵

Type	Make	Model	Quantity	Emissions (m <sup>3</sup> /h)	Value of Gas (\$/y)	Carbon Credits (\$/y)	Total Potential Value (\$/y)	Comments	
Methanol Injection Pumps	Bruin	BRX313S P-2511	1	1.3786	1,658	2,581	4,239		
		BRX313S P-2511	1	2.1624	2,600	4,049	6,649		
		<b>Average (per pump):</b>			<b>1.7705</b>	<b>2,129</b>	<b>3,315</b>	<b>5,444</b>	
	CVS	B-548	1	0.6723	808	1,259	2,067		
		<b>Average (per pump):</b>			<b>0.6723</b>	<b>808</b>	<b>1,259</b>	<b>2,067</b>	
	Texsteam	5100	2	0.6953	836	1,302	2,138	Meter Shack	
		5100	2	0.501	602	938	1,540		
		<b>Average (per pump):</b>			<b>0.2991</b>	<b>360</b>	<b>560</b>	<b>920</b>	
		MX331AB W02	1	0.1105	133	207	340		
		MX331AB W02	1	0.2689	323	503	827		
		MX331AB W02	1	0.1451	174	272	446		
		<b>Average</b>			<b>0.1748</b>	<b>210</b>	<b>327</b>	<b>537</b>	
	<b>All</b>	<b>Average (per pump):</b>			<b>0.5934</b>	<b>714</b>	<b>1,111</b>	<b>1,825</b>	