DEVELOPMENT OF A NEW MODEL OF PA-13A/12A HIGH CALORIE GAS PORTABLE GENERATORS

Shigeo Akiyama, Technological Research Section, Buyo Gas Co., Ltd.
Yasuyoshi Tsutsui, Production Section, Distribution Department, Matsumoto Gas Co., Ltd.
Kenichi Uehara, Development Section, Engineering Department, Ito Koki Co., Ltd.
Hideki Saito, Distribution Department Engineering Center, Hokuriku Gas Corporation

1. DEVELOPMENT

(1) Development motives and objectives

The conventional model of portable gas generator, developed in 1995, had the following inconveniencies:

a. An injection pressure of 0.15 MPa was required at the venturi mixer nozzle. Therefore, gas production could be difficult in cold regions due to the lower vapor pressure of the source propane.

b. There were inconveniences in handling, storage and transport.

c. Since these conventional gas generators provide 13A gas only, they cannot be used by providers of 12A gas.

(2) Concept

We established the following concept for the new model of portable gas generators to overcome these inconveniencies of the conventional model:

a. During winter in cold regions, gas production should be possible even at the ambient temperature of -5°C to -10°C, and at the source propane liquid temperature of -25°C (vapor pressure of 0.15 MPa).

b. The gas generator should be capable of producing not only 13A gas but also 12A gas. This will enable cooperation between 13A gas providers and 12A gas providers in disaster relief activities.

c. The new model should be smaller, lighter, and easier to handle than the conventional model.

d. In spite of its higher performance, the new model should cost the same or less than the conventional model.

(3) Development details

To achieve the objective, our development work focused on the following.

a. Ease of gas production in cold regions

Since a PA high calorie gas portable generator should be designed as a standalone system capable of producing gas by taking in air using the naturally-available propane vapor pressure without relying on any external energy supply, the venturi mixer efficiency should be improved to achieve a higher aspiration performance, allowing a lower injection pressure at the nozzle (i.e. allowing a lower vapor pressure to be used). Therefore, we studied the nozzle configuration, throat surface area ratio and pressure recovery section design, and then fabricated nozzle and throat components that would enable gas production at the ambient temperature of -10°C (injection pressure of approximately 0.09 MPa at the nozzle).

In the past we based designs on test results, but this time we shortened the development period by performing calculations beforehand.

We improved the control system to prevent malfunctioning at a lower operating temperature.

b. Stabilization of the calorific value

Since gas production is achieved by means of a venturi mixer, air cannot be taken in momentarily at the beginning and end of a gas production operation, causing fluctuations in the calorific value. Even though we decided to decrease the cushion tank capacity to make the equipment smaller, this could lead to the insufficient buffering of calorific value fluctuations. To prevent this, we made the gas passage as narrow as possible. However, a narrower gas passage could induce operating transients such as hunting, which again could lead to calorific value fluctuations. We solved these conflicts by improving the control system.

c. Achievement of compatibility among gas types

Initially, we set the performance point in the 13A/12A overlapping region to enable the production of both types of gas without needing part replacement or readjustment. However, after further studies, we finally decided to achieve 13A/12A compatibility by nozzle replacement. In this way, the new portable gas generator can provide both 13A and 12A gases, allowing inter-regional cooperation (transfer of equipment) between 13A gas providers and 12A gas providers.

d. Smaller and lighter

The conventional model used a propane container as a cushion tank. In the new model, the tank was made smaller and components were combined into a single block. This has made the equipment lighter, smaller and easier to assemble.

Both the 4 m^3/h type unit and the 30 m^3/h type unit are about 40% lighter. The 4 m^3/h type unit can be carried by a single person while the 30 m^3/h type unit can be transported by a small car. Thus, handling and installation have been made easy.

Comparison between the conventional and improved models (30 m^3/h type)

Conventional model

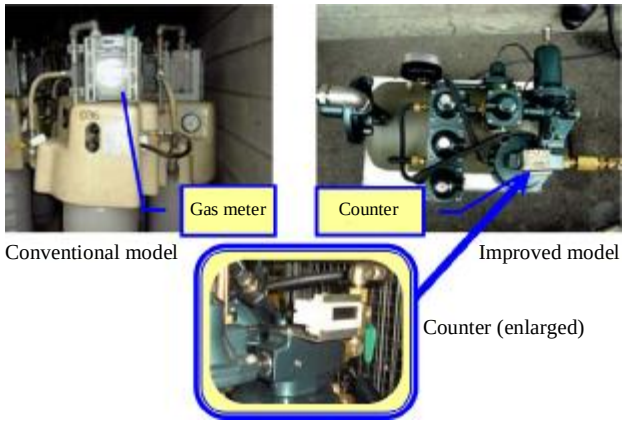
Improved model on the right

Comparison between the conventional and improved models (4 m^3/h type)
Left: conventional model
Right: improved model

e. Simplified monitoring of the level of remaining source propane

While the conventional model used a gas meter for monitoring the level of remaining source propane, in the improved model this has been replaced by a counter type display (based on the measurement of the gas production hours). This change improves the appearance, making the equipment look less awkward at the installation site.

Monitoring of the level of remaining source propane



f. Easy procurement of gas production source

Since an air aspiration type gas generator like this uses propane as the production source, the production source can be obtained more easily anywhere in Japan compared with other types of portable gas generators.

g. Larger capacity

Once installed, the equipment can continue to supply gas to an average household for about a month or longer.

Product specifications:

Type	PA－13A 4N	PA－12A 4N	PA－13A 30N	PA－12A 30N
Dimensions W x H x D	610 x 660 x 390	610 x 660 x 390	1200 x 1800 x 600	1200 x 1800 x 600
Weight	25 kg	25 kg	280 kg	280 kg
Cushion tank capacity	0.02 m^3	0.02 m^3	0.12 m^3	0.12 m^3
Production source specifications	Propane content 95% or higher Operating pressure range: 0.15-1.56 MPa	Propane content 95% or higher Operating pressure range: 0.15-1.56 MPa	Propane content 95% or higher Operating pressure range: 0.15-1.56 MPa	Propane content 95% or higher Operating pressure range: 0.15-1.56 MPa
Venturi mixer	Nozzle pressure: 0.08-0.10 MPa Nozzle dia.: 1.95 Throat dia.: 2.85 Area ratio: 2.136	Nozzle pressure: 0.08-0.10 MPa Nozzle dia.: 1.85 Throat dia.: 2.85 Area ratio: 2.373	Nozzle pressure: 0.08-0.10 MPa Nozzle dia.: 5.25 Throat dia.: 7.70 Area ratio: 2.151	Nozzle pressure: 0.08-0.10 MPa Nozzle dia.: 5.05 Throat dia.: 7.70 Area ratio: 2.325
Produced gas	Max. capacity: 4 m^3/h Gross calorific value: 62.8 MJ/m^3 (15,000 Kcal/m^3)	Max. capacity: 4 m^3/h Gross calorific value: 58.6 MJ/m^3 (14,000 Kcal/m^3)	Max. capacity: 30 m^3/h Gross calorific value: 62.8 MJ/m^3 (15,000 Kcal/m^3)	Max. capacity: 30 m^3/h Gross calorific value: 58.6 MJ/m^3 (14,000 Kcal/m^3)

2. UTILIZATION

These portable gas generators offer the following advantages:

(1) Lower cost of gas pipe replacement

The replacement of gas pipes and supply lines (e.g. in a counter-aging program) used to require a bypass operation, which involved the placement of a new piping before switching from the existing piping. By using a portable gas generator, however, it is possible to perform the work without interrupting the supply of gas to customers, and moreover, the new piping can simply replace the existing piping in the same space. This approximately halves the digging area and reduces the work expenses by about 30-40%.

For the same reason, the conventional model of portable gas generators has already reduced civil engineering work expenses by 20 to 30%.

Since the new portable gas generators are smaller and designed for use in cold regions, they can be used in more construction products with additional numbers of units at sites where space is limited, and with higher availability in winter.

(2) Simplification of work

Since the new piping can replace the existing piping in the same space, and the work period is shorter, it is easier to obtain a work permit from the road administration authority.

(3) Higher efficiency of calorific value adjustment

Since the new portable gas generators are small, light and can be used in cold regions, they can be used for improving the efficiency of the preliminary adjustment of calorific value and the pre-winter adjustment of calorific value in cold regions.

(4) Convenience in disaster relief activities

Since 13A/12A compatibility is achieved by the replacement nozzle stored in a box attached to the equipment, gas companies in different regions can send these portable gas generators to an area struck by disaster after simply changing the nozzle as required. The recipients at the disaster-struck area can then promptly start up the generator.

(5) Low noise

The noise level of the improved model is just 55 dB compared with 65 dB for the conventional model. This reduces complaints from customers using the equipment.

(6) Higher safety

Using portable gas generators, it is possible to replace or repair gas pipes without interrupting the supply of gas to customers. Thus, gas companies can do the work at their own pace without pressure of time. This reduces human errors from rushing and prevents accidents.

3. CONCLUSION

These portable gas generators are already used by many gas companies as an aid for calorific value adjustment, gas pipe replacement and repair, disaster relief, and gas sales promotion.

The developers expect that use of these portable gas generators will expand, thus contributing to the growth of the industry.