# Why Gas?

***By MAJ Linda Shockley***

At Ypres, Belgium on 22 April 1915, a five-mile-long greenish-yellow cloud of chlorine gas slowly rolled across no-man's-land toward the allied trenches.[1] Germany had just launched the first effective large-scale use of chemicals in war. As World War I progressed, "poison gas" was to become one of the fastest developing new forms of warfare. By the end of this war, more than 1.25 million soldiers would become gas casualties.[2] What led Germany to employ the products of chemistry as weapons? Were these new weapons effectively integrated with conventional fires?

This quote from the Chief of the Great General Staff, General Erich von Falkenhayn, reveals the impetus to develop a new way to fight in the trenches.

"The ordinary weapons of attack often failed completely (in trench warfare). A weapon had, therefore, to be found which was superior to them but would not tax the limited capacity of the German war industry. . .Such a weapon existed in gas."[3]

To further his concept, Germany had an exceptional organic chemical industry. Additionally, two of the greatest chemists of that era were patriotic Germans who felt compelled to do everything possible for the war effort. Finally, influential German officers were able to recognize the potential of these war gases and develop doctrine and tactics to employ them successfully.

The industrial base which enabled Germany to mobilize chemistry for war was the Interessen Gemeinschaft or I.G. Eight giant chemical combines situated in the Ruhr valley comprised the I.G.[4] Using highly efficient mass production methods, they had acquired a virtual monopoly in the world manufacture of dyes.[5] By the early 1900s, they were completely independent in all matters relating to production of dyes, especially raw materials.

Other German industry was not as self-sufficient. By late 1914, the British naval blockade had been successful at cutting off the supply of Chilean saltpeter.[6] This was Germany's primary source of sodium nitrate, which was used to manufacture nitric acid, an essential intermediate for high explosives. With a shortage of high explosives looming over them, the German High Command tasked

***French artillery unit after fighting through a gas attack. The gun is mottled and concealed by shrubbery. The gunners fought through the attack and are continuing now that the cloud has passed. The man at the right is making a report. A Red Cross worker is attending a wounded comrade.***

the dye industry to explore the feasibility of using chemicals as weapons. The I.G. had not only their own research organizations, but could also collaborate with the scientists at the Kaiser Wilhelm Institute and the University of Berlin.[7]

Professor Walther Nernst of the University of Berlin was the first to advocate the use of gas as a weapon on the battlefield.[8] However, the driving force for the practical application of his concept was the brilliant chemist, Fritz Haber of the Kaiser Wilhelm Institute. He was placed in charge of field operations and worked tirelessly to test compounds and methods of dissemination, personally supervising the use of chlorine gas at Ypres.[9] Falkenhayn appointed him as the Director of the German Chemical Warfare Service in 1916.

Haber, in addition to his work with chemical agents, developed an industrial method to synthesize ammonia from hydrogen and nitrogen from the air. Ammonia provided another route to produce the nitric acid needed for explosives.[10] In spite of the effective British blockade, the German chemical industry, by using the Haber process, was able to provide the explosives and fertilizers necessary for the war effort. The war might have ended much sooner had it not been for the work of Fritz Haber.

The chemicals selected as war gases by Haber and his researchers fall into two classifications.[11] Compounds such as chlorine, phosgene, and mustard were actual intermediates in the manufacturing process of dyes used in peacetime. Others, such as xylyl bromide and diphosgene, could be prepared by making slight modifications to existing techniques and equipment. Perhaps most importantly, plant workers were experienced in dealing with hazardous chemicals. Consequently, German dye plants were readily converted, with minor retooling, for production of war gases.

For any weapon to be successful in modern war, it must be efficiently mass produced in quantities adequate for effective employment. At this time, the production capacity of the I.G. had no equal in the world.[12] Chemical agents could be manufactured on the required scale with raw materials and machinery normally used in the dye industry. The policy of self-sufficiency followed by the I.G. enabled them to sustain this effort for the duration of the war.

The last advantage which the I.G. imparted to the German war gas mission was that of timeliness. After a chemical agent was tested and approved, the factories required only a few weeks to make it available to the field.[13] Because of this production base, gas was a much more flexible weapon for the Germans than for the allies. The allies routinely took months to field a new agent. The lack of a strong organic chemistry industry in any allied country put each of them at a severe disadvantage compared with the Germans.[14] Germany not only possessed "interior lines" in the gas manufacturing war but also devised an efficient system to employ the gas weapons once they were fielded.

During the spring of 1915, chemical agents, in the form of "cloud gas," were released from pressurized containers emplaced in the German front lines. This method of employment was totally dependent on the wind blowing in the proper direction. Cylinders often leaked; sometimes an early warning of a gas attack was provided by the thousands of rats scurrying to safety across no-man's-land.[15] Extensive organization and coordination were required to move these heavy cylinders to emplacement positions in the front lines. The enormous mechanical and muscular effort was provided primarily by the infantry, further sapping their strength before an attack.[16] These reasons led to the development of gas-filled artillery shells.

The first German gas shells were 105mm projectiles with a sternatutory

*German Artillery-Delivered Chemical Agents (World War 1)*[19]

| Agent | Shell Marking | Physiological Effect | Persistency |
|---|---|---|---|
| Diphenyl chlorarsine | Blue Cross | Sneezing gas; respiratory irritant | Nonpersistent |
| Diphenyl cyanarsine | Blue Cross | Sneezing gas; respiratory irritant | Nonpersistent |
| Phosgene | White D | Lethal respiratory irratant | Nonpersistent |
| Diphosgene | Green Cross | Lethal respiratory irritant | Semipersistent |
| Diphosgene & chlorpicrin | Green Cross 1 | Lethal respiratory irritant | Semipersistent |
| Phosgene, diphosgene & diphenyl chlorarsine | Green Cross 2 | Lethal Respiratory irritant | Semipersistent |
| Brom ketones | Green Cross | Tear gas; respiratory irritant | Persistent |
| Dichlorethyl sulfide (Mustard gas) | Yellow Cross | Delayed-acting blister agent | Persistent |

(sneezing) powder replacing the explosive in which shrapnel was normally embedded.[17] When the shell detonated, this powder was pulverized and very rapidly dissipated. Because of this rapid dispersion, these munitions were not effective in the field. Subsequent development used liquid agents which gave improved intensity and persistency of effects. Projectiles were still ballistically sound with the liquid fill. The Germans first used gas shells late in 1915, France in 1916, and Great Britain in 1917. By 1918, 20% to 33% of all artillery shells produced were filled with chemicals.[18] The types of agents used by the Germans and the artillery shell marking system by which they were known are summarized in the table on page 3.[19]

To develop and implement doctrine for the employment of artillery delivered gas, the Germans designated a special gas expert on each division artillery staff.[20] Rather than bringing in an outsider, the Germans would select an artillery officer already on staff for special training. This expert maintained very close liaison with the division gas officer. Because of this approach, artillerymen developed an almost paternal interest in gas warfare. One artillery officer, LTC Georg Bruchmuller, would be most influential in the successful application of chemical weapons.

Bruchmuller, regarded by others as an artillery genius, was an early convert to integrating gas into fire support plans. One of his greatest contributions led to the capability to deliver true surprise attacks with gas.[21] Previously, one gun in each battery fired until it was on target, then passed the range data to the other guns. Thus, the enemy always had warning before a barrage. Bruchmuller developed a technique of calculating ranges from meteorological and firing data. This "predicted" fire or survey method of gun-laying enabled the Germans to fire barrages without warning.

Primary targets for chemical weapons were artillery positions and troop assembly areas. Bruchmuller designated these targets as "gas squares" and would saturate the area with surprise gas attacks.[22] After Blue and Yellow Cross shells became available, combinations of chemical shells were fired at targets in "buntkreuz" (colored cross) tactics to achieve a synergistic effect.[23] These tactics were extremely effective for counterbattery fire. Neutralization of enemy artillery with high explosives could take days and would consume many tons of shells. With gas, especially Yellow Cross (mustard), an artillery battery could be neutralized in 15 minutes with only a few shells.

Initially, Germany had the advantage in all aspects of chemical warfare. Her planners recognized the possibilities of gas as a weapon which could be deadly in the trenches. Her unparalleled industrial base and brilliant chemists enabled her to achieve technical surprise by the sudden introduction of an entirely new weapon. Because of the types of chemicals chosen, civilian dye factories were readily converted into chemical agent plants. The stockpiles of raw materials maintained by the I.G. permitted them to produce new agents quickly in vast quantities for nearly four years. The war industry provided the munitions needed to deliver gas on target.

Systems to support this new form of warfare were established by officers who recognized its potential. Highly sophisticated tactics for the employment of gas evolved rapidly. Chemical weapons were indeed effectively integrated into fire support. However, gas alone could not win the war; it had to be backed by a powerful offensive. German forces were unable to exploit the initial advantages given them by chemical weapons.

Notes


1. Victor Lefebure, *The Riddle of the Rhine* (New York: E. P. Dutton and Company, 1920), 31.
2. Alden H. Waitt, *Gas Warfare* (New York: Duell, Sloan and Pearce, 1942), 22.
3. William Moore, *Gas Attack!* (New York: Hippocrene Books, Inc., 1987), 13.
4. Lefebure, *The Riddle of the Rhine*, 151.
5. Robert Harris and Jeremy Paxman, *A Higher Form of Killing* (New York: Hill and Wang, 1982), 8.
6. Harris and Paxman, *A Higher Form of Killing*, 9.
7. Lefebure, *The Riddle of the Rhine*, 85.
8. Waitt, *Gas Warfare*, 16.
9. John C. Kotz and Keith F. Purcell, *Chemistry and Chemical Reactivity* (Philadelphia: Saunders College Publishing, 1987), 822.
10. Therald Moeller, et al., *Chemistry With Inorganic Qualitative Analysis* (New York: Academic Press, Inc., 1984), 625.
11. Lefebure, *The Riddle of the Rhine*, 155-158.
12. Harris and Paxman, *A Higher Form of Killing*, 10.
13. Lefebure, *The Riddle of the Rhine*, 83.
14. Ibid., 110.
15. Harris and Paxman, *A Higher Form of Killing*, 24.
16. Lefebure, *The Riddle of the Rhine*, 58-59.
17. Ibid., 40-41.
18. Harris and Paxman, *A Higher Form of Killing*, 23.
19. Charles P. Heller, *Chemical Warfare in World War I:* The American Experience. Leavenworth Papers No. 10. (Ft. Leavenworth, KS, 1984), 15.
20. Lefebure, *The Riddle of the Rhine*, 91.
21. Moore, *Gas Attack!*, 153.
22. Heller, *Chemical Warfare in World War I: The American Experience*, 25.
23. Ibid., 26.



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