AERIAL IGNITION SYSTEMS IN BRITISH COLUMBIA, CANADA

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I. INTRODUCTION

In British Columbia several aerial ignition systems are used, the gas/diesel/JP-4 drip torch, the gelled gasoline helitorch and the aerial ignition device (AID). This paper deals mainly with the experiences of MacMillan Bloedel Ltd. and Forest Industries Flying Tankers while using the gelled gasoline helitorch. The reason for using any one of these systems is to meet management objectives in the most efficient and safe manner.

Aerial ignition systems are preferred to ground ignition for the following reasons:

- safety
- fewer personnel problems, i.e., training, union seniority, availability, smaller crews, etc.
- aerial ignition costs are usually less
- ignition patterns can be changed easily to use fire to control fire
- sensitive sites can be burned more easily under marginal burning conditions
- by burning in the early spring, under marginal burning conditions, the risk to adjacent values is reduced.

II. HISTORY OF TORCH DEVELOPMENT

The Australians used aerial ignition before the 1970s. I believe our interest was sparked by their success. On this continent aerial ignition systems were initially developed in Canada by the Canadian Forest Service in Victoria and Edmonton. Because of their involvement, both the AID and helicopter-slung drip torch were well publicized.

In the early 1970s John Muraro invented the flying drip torch while working for the Canadian Forest Service. He was also one of the key men in the development of the AID machine. By 1974-1975 Okanagan Helicopters in British Columbia built a very effective drip torch which used any of the flammable liquids. This was the first hockey stick torch. In the late 1970s Western Helicopters of Newberg, Oregon and Simplex Manufacturing developed an ignition system which used Napalm. This new fuel torch was a significant step forward in the development of aerial ignition systems.

The most recent model of the helitorch in British Columbia is one built by Forest Industries Flying Tankers of Sproat Lake. They combined the best features from other companies, developed some new features and came up with the FIFT torch. The torch will be described later.

Helicopter ground operations and mixing systems were given little attention in the early years of development. Basically, all mixing was done from the back of a pickup truck until about 1980. In 1982 Quick Helicopter Co. in Washington state were using an improved mixing system

consisting of a 890 L (200 gallon) pesticide chemical tank which they modified by installing internal paddles. At the same time Simplex had their internal paddle mixing drum for sale. Both systems seemed to work well.

The original torch that John Muraro invented has changed dramatically. It seems that every six months new gelling agents, fuels, igniters, mixing drums, safety procedures, etc., are being introduced. In British Columbia Forest Industries Flying Tankers Ltd. has recently developed a most effective and safe helitorch.

III. FOREST INDUSTRIES FLYING TANKERS' HELITORCH

Forest Industries Flying Tankers Ltd. is an aerial firefighting company owned by a consortium of forestry companies on the coast. MacMillan Bloedel Ltd. is the major owner. FIFT operates the last two of nine original Martin Mars flying boats, one Grumman Goose and three 206 L1 Long Rangers helicopters. They use all aircraft to fight wildfires. The helicopters are used to light fires also.

The FIFT torch consists of two distinct parts, i.e., a one-piece hockey stick which fits on top of the fuel drum, and a Buckmaster fuel drum. The fuel drum has expanded aluminum paddles, grooves for barrel hooks, a sump, camlock fittings, support feet and non-spill lid. All internal parts are constructed of non-ferrous metals.

The hockey stick torch has a built on pump, electrical propane ignition, electrical circuit breaker, carrying handle, attachment hooks and nozzle. It is designed with safety as a top priority.

In addition there are:

- Spreader bar arrangements to ensure the torch flies properly and stays within the helicopter's center of gravity limits (there is no weight put on the skids). The electrical connection is to the water bucket receptical.

- Cleanup equipment consisting of a hose and extension cord. The cleanup hose attaches at the nozzle camlock and solvent is circulated through the system back into the tank. The cleanup procedure is done with the igniter circuit breaker pulled and the propane valve off. The extension cord allows the helicopter to detach itself from the torch and separate at least 16 m (52 feet) from the cleaning operation.

- The nozzle quickly detaches from the torch by camlock fittings. It can be cleaned very easily if plugged with lumps of chemical and it does not drip when the pump is turned off.

- Gelled fuel is pumped by an aircraft positive pressure transfer pump. The pump pressure spring was modified so it would pump 30 psi. The pump only draws a maximum of 10 amps.

This torch was built from scratch and much of the design technology was supplied by FIFT's engineers. Technology from other torches was already available. FIFT has offered to share their knowledge with whomever is interested. You can deal directly with them at their Port Alberni address: R.R. 3, Port Alberni, B.C. V9Y 7L7 (604/723-6225).

The FIFT torch cost about $2,000 (Cdn) plus labour to build.

The high-flying, 71 kg (156 pound) FIFT torch is well suited to the variable conditions in British Columbia.

IV. DESCRIPTION OF CONDITIONS IN BRITISH COLUMBIA

Prescribed burning conditions in B.C. are diverse. The vegetation, climate, topography and soils are so varied that it is difficult to generalize. We have coastal rain forests, dry coastal forests, bunch grass prairie, near desert conditions, transitions between all zones, high and low elevations (all above sea level), northern latitudes and more. Topography ranges from extremely steep to flat with all variations in between and on all aspects.

My particular geographic area of concern is the wet and dry coastal forest (75 to 250 mm or 30 to 100 inches of precipitation) which extends from the sea eastward about 120 kilometers (75 miles) and in a north and south direction of about 720 kilometers (450 miles). Forest soils are seldom more than 2 m (6.5 feet) deep and some sites are very fragile and sensitive to fire.

Tree species are mostly western redcedar, western hemlock and Douglas-fir. Slash fuel loading is usually continuous and from 44 to 440 tonnes per hectare (20 to 200 tons per acre).

In British Columbia land management objectives dealing with reforestation, hazard abatement and wildlife habitat improvement usually include the use of prescribed broadcast burning, and therefore aerial ignition.

V. MB EXPERIENCES WITH AERIAL IGNITION

The original gas/diesel/JP-4 drip torch was and still is a good tool. It is used extensively in the interior of B.C. where topography is not as severe as on the coast. On the coast MB quit using the drip torch in 1978 because of our difficult terrain and its low-elevation flying requirements. AIDs were used exclusively by MB until 1982 when the alumagel helitorch was experimented with. After much work during 1983 and 1984, the FIFT torch was operational.

MacMillan Bloedel Limited burned about 3,300 hectares (7,260 acres) on about 70 settings in 1983. All methods of ignition except the drip torch were used. We used the helitorch about 50 percent, AIDS 30 percent and hand ignition 20 percent of the time. This year (1984) the helitorch was used on at least 70 percent of the broadcast burns.

A. Fuel Handling

Gasoline is still transferred in large and small tanks. The main difference today, as opposed to past years, is that we separate our mixing operation by at least 16 m (52 feet) from the fuel supply. We use proper fuel nozzles, camlock fittings and ground and bonding procedures. We also keep the helicopter at least 92 m (300 feet) away from the mixing site, except when picking up a load.

B. Mixing Operations

Of course there are the old open-top fuel drum recirculation system and the hand-job paddle mixing methods. On the coast of B.C. these methods are becoming obsolete.

MacMillan Bloedel and FIFT experimented with several methods of fuel mixing. First a centrifugal pump system with hoses, barrel and grounding wires was used successfully, but the system was somewhat cumbersome. Second, a completely containerized system was designed which included fuel storage in one portion of a large tank and mixed chemical in another compartment. This design never left the drawing board because of its high cost and because one of MB's employees built and tested a paddle mixing drum that worked well. We named the new drum "Buckmaster" after the designer, Mr. Ray Buck.

As far as volume goes, we found that three Buckmaster drums were sufficient to keep ahead of one helicopter when mixing alumagel or Surefire (Calford G-760, manufactured by H.L. Blachford Ltd., Mississauga, Ontario).

C. Chemical

This year MB bought 1,000 kg (2,200 pounds) of "Surefire" (Fireflex Manufacturing's trade name for Calford G). It gells faster, and less than half as much is required compared to alumagel. So far it has saved money in its initial cost and in helicopter time. We have had no complaints. Other chemicals such as peptizers are strictly prohibited.

D. Ground Operations Procedure

In 1979 experiences with the alumagel helitorch were disappointing. There were igniter, gelling problems, and the drums of fuel were difficult to mount on the frame. Chemical mixing ratios were not understood and, in particular, logistics were difficult.

Although there were many negative factors, a few of us bowed our necks and set about to modify and improve what we had. Eventually, the above-mentioned FIFT torch evolved.

Our operations are made up of a pilot, two crewmen and an ignition technician (or sometimes the fire boss). The ignition technician flies throughout most of the ignition phase. However, in some areas

the pilot flies alone. (The ignition technician is part of the flight crew when he flies.) We found that the ignition technician has more control and light up flexibility when he flies than when he stays on the ground. An inexperienced ignition technician or fire boss can gain invaluable experience in the air and pilots can learn from experienced fire bosses.

There is a senior ground crewman who controls ground activities and at least one ground crewman. The fueling site is at least 92 m (300 feet) from the heliport which is the helicopter staging area.

We use either Bell 206B Jet Rangers or 206 L1 Long Rangers. With the Bell Jet Ranger, under marginal flying conditions, the pilot has the option of downloading his helicopter fuel or of asking for half drums of gelled fuel because of weight restrictions. This is much less of a problem with the higher powered Long Ranger.

Regular gasoline is usually supplied from a tank truck, but on occasion comes in 203 L (45 gallon) drums. Where possible we use the local fuel distributor and his equipment. The gasoline supply and Buckmaster mixing drums are separated by at least 16 m (52 feet).

The first-aid attendant is always available, but not always on site. Burn packs, first aid kit and water are required when burning.

The helicopter is required at least one-half hour before ignition for reconnaissance and pilot briefing. Fuel mixing is started at least one-half hour before lightup is planned to ensure the right consistency of gel. Once burning starts the mixing operation continues until the fire boss orders otherwise.

Throughout the operation safety is our main concern. Federal air regulations do not restrict the operation. The provincial Workers' Compensation Board regulations, the National Fire Codes and company regulations ensure ground operations are safe. Video tapes (VHS) have been taken at demonstrations and during slashburns by Ray Buck. MB uses these tapes and others to train company personnel in safe ground operating procedures. FIFT frequently have field demonstrations of the operation as well.

E. Application Rates and Costs

Fuel application rates average one to three drums per 45 hectares (100 acres). Mixed wood settings or moist fuels have taken more fuel. The least fuel used was one-half drum and the most four drums per 45 ha (100 acres). Gasoline costs $97 (Cdn) per load (45 gallons) and "Surefire" $12. Therefore gelled fuel costs from $1.01 to $9.60/ha ($.46 to $4.36 per acre).

For comparison, AID system ping pong balls cost $.17 each. We have used as few as 20 (9 per acre) and as many as 220 per ha (100 per acre). Therefore the cost of the balls is from $3.40 to $37.40 per ha ($1.53 to $17 per acre). Helicopter costs are about the same for helitorch and AID burning.

Helitorching requires two or three men at the mixing site and AID burning only requires one machine operator in the helicopter.

Helicopter pilots can apply various amounts of gelled fuel by varying their air speed and toggling the dispensing switch on/off. Gel spread patterns can be varied by flying at various elevations, speeds and again by toggling the dispensing switch on/off. Generally, about 2 km (1.3 mile) of ignition line can be lit with one drum of fuel.

Helicopter costs $500 (Cdn) per hour (206 L1). Flying costs depend on many variables but average one hour flying per 45 ha (100 acres). The wettest areas have required more fuel but not necessarily more flying time.

VI. JUSTIFICATION FOR HELITORCHING

Helitorches have provided MB with the opportunity to burn more often and more precisely than with other ignition tools. They have also caused us to spend more money and time on planning. The helitorch has a slight edge over other methods when lighting mixed wood settings, brushy areas or fuels with high fine fuel moisture content. The critical fuels seem to be those medium ones of 3 to 10 centimeters (1.5 to 4 inches) in diameter. If they will ignite, then the fire will spread when fuel is present.

Immediate advantages of helitorching are:

- You can see how the fire is going to behave before advancing further with your ignition.
- You can effectively vary the ignition pattern to use fire to control fire.

The limitations of helitorching are:

- Logistics
- Ground operation

Considerable planning is necessary to ensure a successful operation. Because we use gasoline, safety procedures are most important.

VII. SAFETY ON THE GROUND

Before proceeding further, several safety instances are worth describing. The AID system has been fairly incident free, however, there are tales of dispensers clogging, smoke filling the cockpit, etc. The only safety incident I am aware of with the AID system happened in 1983. A dispenser operator put his thumb in the glycol injector chamber and the glycol dispenser needle went through it. No, the operator did not ignite in 30 seconds, nor did he freeze that winter.

. In 1974 while driptorching, a Long Ranger engine overreved and then lost power. The pilot jettisoned the burning gas/diesel torch and slid onto a nearby road. There were no injuries or damages.

. In 1981 an Australian alumagel torch exploded covering the bottom of the helicopter (Aerospatiale AS350) with burning alumagel. The pilot landed, escaped and watched his aircraft burn.

In this case the design of the torch was at fault. It consisted of a pressurized fuel tank with an igniter and nozzle. Pressure was supposed to be supplied from an inert gas, but someone had used air instead and there was a flashback through the piping into the tank; consequently an explosion.

The solution to the problem appears to be better standardization and testing of torches. Government should help set the standards and do research while industry should be responsible for regulating.

. In 1982 an alumagel fuel mixing site caught fire, and again in 1984 an alumagel mixing site caught fire. A pickup truck was lost and one man slightly burned in the 1984 experience.

Both operations had the fuel supply and mixing drums within 3 m (10 feet) of each other. Both operations practiced poor housekeeping.

Spilled fuel was on the ground, and in the most serious incident, the helitorch had been tested in the mixing area. Both operations allowed the helicopter to fly over the mixing and fuel site during ingress and egress.

Cause of one fire was burning residual fuel dropping from the torch. In the other instance fire was caused by burning test fuel, or caulk boot sparks, or static electricity, or it involved the pickup truck the crew was working out of.

Those were a few incidences to show you the importance of safety and the consequences of error in the operation of the helitorch system.

Although our ground crews follow existing standards and regulations to the best of their ability, accidents may happen as noted previously. To improve safety we wrote a guide called "Operating Procedures for Helitorch Ground Operations."

The guide covers:

- Planning the operation
- Position descriptions, duties and responsibilities
- Description of work site and equipment
- Description of mixing operation
- Lift-off procedures
- Regulations that we work by, and
- Checklists of things to do, etc.

VIII. SUMMARY

A. Safety is the main concern. There is a well-defined procedure for conducting gelled gasoline ground operations. An operations procedure guide was written, video tapes are used and field demonstrations are provided to all logging division. All applicable Federal, Provincial and Company regulations are followed.

B. MB has used the AID system extensively. However, with the gelled fuel helitorch available, AIDs are now used only about 20% of the time. Hand lighting is only done when aerial ignition systems are not available and on small units.

C. Fuel mixing has been done using various methods. Using the Buckmaster fuel drum has proven best for MB.

D. There are two chemicals for gelling gasoline. Surefire (Calford G) is preferred because half as much is needed and gelling time is twice as fast. No peptizers are allowed.

E. Application rates range from one-half to four drums per 45 hectares (100 acres).

F. Gellied fuel costs $1.01 to $9.60 per hectare ($0.46 to $4.36 per acre). Aircraft costs about $11 per hectare ($5 per acre). AID ping pong balls cost $0.17 each, or $3.40 to $37.40 per hectare ($1.53 to $17 per acre).

G. Helitorch operations require considerable organization and manpower whereas AID operations are less labour intensive.

H. The advantage of gelled fuel is that the ignition technician and pilot can see how the fire is going to behave before advancing ignition further. They can effectively vary the ignition pattern to use fire to control fire.

I. Helitorches come in several varieties. The most successful in our area is the Forest Industries Flying Tankers design.

J. Many people, agencies and companies have been involved in development of aerial ignition systems. There is still more work to be done on:

- Safety procedures
- Methods of handling combustible liquids
- Use of new fuels
- Improved torch design
- Standardization of equipment between agencies and helicopter companies.