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DEVELOPMENT OF A 16 MW_{th} COAL-WATER FUEL/HEAVY OIL BURNER FOR FRONT WALL FIRING.

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DEVELOPMENT OF A 16 MW_{th} COAL-WATER FUEL/HEAVY OIL BURNER FOR FRONT WALL FIRING.

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INTRODUCTION

Coal-water fuels (CWF) may be used as a replacement for oil and pulverized coal in utility and industrial boilers and process combustors. The advantages of fuel substitution are that the change-over to coal can be attempted with minimal modifications to hardware in existing oil firing plants. These benefits which eliminate the need for bulk coal transportation, storage, handling and conveying equipment also engender the application of CWFs from environmental considerations. Preliminary results from a CWF demonstration program(1) in a tight oil-designed boiler without evidence of convective tube erosion, or maximum capacity reductions (derating), show that CWFs may also usher a new era in the design of more compact boilers for clean coal combustion(2).

Despite these potential benefits and attractions, CWF deployment, after almost a decade of R & D, continues to be hampered by the availability of efficient and reliable CWF burners. The common difficulties encountered include an inability to efficiently atomize the fuel, erosive wear in two fluid atomizers, poor ignition stability and turn-down in burners. Many of these problems can be attributed to the almost universal adaptation and use of oil-designed, fuel nozzles and burner registers for CWF combustion(2,3). The difficulties in this approach are that CWFs due to their two-phase (solid-liquid) nature and high (nominally 30 wt%) moisture content are mis-matched to oil-designed burner equipment, because of fundamental differences in their atomization behaviour and burning profiles in comparison to oil. In addition, it is also clear that there is a poor understanding of fuel properties, burner operation and control parameters critical to good atomization and combustion of CWFs(2).

The present paper reviews those fuel properties and fundamental design principles which govern the mechanism of atomization and combustion of CWFs, and describes a dual CWF/Oil, front wall fired burner that was developed from an application of these principles. Results from a single burner demonstration test undertaken in a 20 $MW_{(e)}$ oil-designed, utility boiler in Charlottetown, Prince Edward Island, are presented. Details of a long term program to evaluate erosion resistant materials in a single burner, industrial steam boiler demonstration, and brief details of a program to evaluate a full complement of 5 burners in the the Charlottetown utility boiler in summer 1988, are also described.

CWF ATOMIZATION FUNDAMENTALS.

MECHANISM AND CONTROLLING FUEL PROPERTIES

The flow properties of CWFs are similar to those of viscous liquids due to a high apparent bulk viscosity, μ_S. Values of μ_S in the 100-2000 mPa.s range are typical, and are 10 to a 100 times greater than the fluid viscosity of oils and water. These high values of μ_S are caused by inter-particle collisions, and surface friction between the high concentration (nominally 70 wt%) solids in CWFs. CWFs also exhibit non-Newtonian behaviour, with dilatant or pseudoplastic properties that are shear rate and time dependent. In view of the 'apparent viscous liquid' properties of CWFs, the accepted view in the technical literature is that CWFs behave like viscous liquids in their atomization behaviour(4,5,6,7). However, this assumption remains largely unproven(2).

Due to the heterogeneous (two-phase) nature of CWFs, it has been proposed that the atomization behaviour, under the influence of the disrupting aerodynamic shear force from the atomizing fluid will likely arise from liquid separation at the solid-liquid interface, or from the breakup of the interstitial liquid between the dispersed solids(2). In the former case, the separation process is governed by the interfacial surface tension of the liquid, σ_L, which serves an

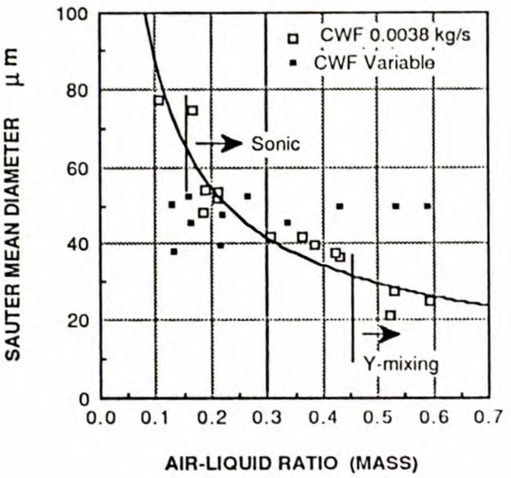

Figure 1-Influence of Air-Liquid Ratio on the Spray Droplet Diameter

approximate measure of the controlling interfacial surface tension forces at the solid-liquid and liquid-air interfaces(2,8). The breakup of the liquid phase between solids, on the other hand, is a phenomenon identical to that encountered in the atomization of homogeneous liquids like water and oils. This mechanism of breakup is controlled by the surface tension, σ_L, and the fluid viscosity μ_L(9). In view of the latter mechanism of liquid atomization, it is clearly evident that the liquid phase viscosity, μ_L, as opposed to the apparent bulk viscosity, μ_s, plays a greater role in the overall CWF atomization process(2). As noted previously, μ_L and μ_s differ significantly in their values, and the viscous component for CWF atomization is therefore at least 10-100 times lower than that predicted if the bulk viscosity, μ_s, was dominant(2).

For the prevailing influence of solid-liquid separation and liquid atomization, the resistance to surface breakup is also lowest at the solid-liquid interface(2). This is due to the controlling influence of surface tension forces as opposed to the combined influence of surface tension and viscous forces resisting interstitial liquid atomization. With surface tension dominated separation, the particle size distribution (PSD) of the coal also plays a key role in the atomization process. The appearance of an aerodynamically induced instability on the CWF surface will first expose the surface of the coarsest particle to frictional drag from the atomizing fluid(2). This initially favours the separation of the CWF into coarse particles and an interstitial liquid layer of fines. The mechanism of surface breakup is repetitive, and eventually promotes the separation of fine particles from the interstitial liquid, if the aerodynamic energy remains high(2). In view of this feature, atomizers which expose a large surface area of liquid, by forming thin liquid sheets and films, are highly desirable for the efficient dispersion of CWFs. In terms of the CWF and atomizing fluid properties, but excluding the role of the PSD which is difficult to quantify, the atomization process may be correlated by the Weber Number(2,8);

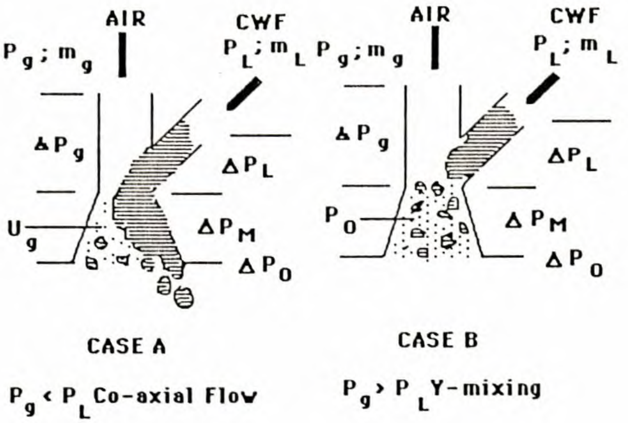

Figure 2 - Flow Mixing Regime Regimes in a Y-Jet Atomizer

$$We = \{ \rho_g U_g^2 D_o / \sigma_L \} \quad (1)$$

where ρ_g is the gas density, Ug the gas velocity and Do is the outlet diameter of the atomizer orifice. The Weber Number represents the ratio of the disrupting aerodynamic force (kinetic energy) of the atomizing fluid, to the consolidating surface tension force that opposes CWF surface disintegration at the solid-liquid interface. The same group is also used to correlate surface tension effects for liquid atomization(9).

PERFORMANCE OF A TWO-FLUID OIL-DESIGNED ATOMIZER

Y-jet atomizers are commonly used in oil firing practice, and the example presented in this section illustrates its performance with CWFs. The adaptation to CWFs usually involves modifications to increase the fuel and outlet orifices to prevent blockage by coal particles, and atomizer fabrication with hardened materials such as tungsten carbide or specialized steels, to minimize erosion by the coal and ash particles(2).

Figure 1 shows the dependence of the spray droplet diameter on the air-liquid ratio (ALR) for a Y-jet CWF atomizer. A number of different operating regimes can be identified for the spray data shown in Figure 1. From calculations of the outlet orifice discharge velocities, the air flow was found to be sonic for the measurements taken at a variable liquid rate. The spray data at a constant air rate of 0.010 kg/s shows no systematic dependence on the ALR, and this behaviour is similar to that found in the sonic regime for a number of different types of CWF atomizers(3,8). For the variable air-constant liquid rate data (at 0.038 kg/s), the droplet diameters decrease with an increasing air flowrate, as may be anticipated from the influence of the Weber Number shown in Equation 1. Two different flow regimes, the first corresponding to an onset of sonic flow at the nozzle exit, and the second corresponding to a transition to a Y-mixing regime were found at ALR values greater than 0.17 and 0.45 respectively. The latter transition to a Y-mixing regime represents a change in the fuel-air mixing configuration within the atomizer mixing chamber.

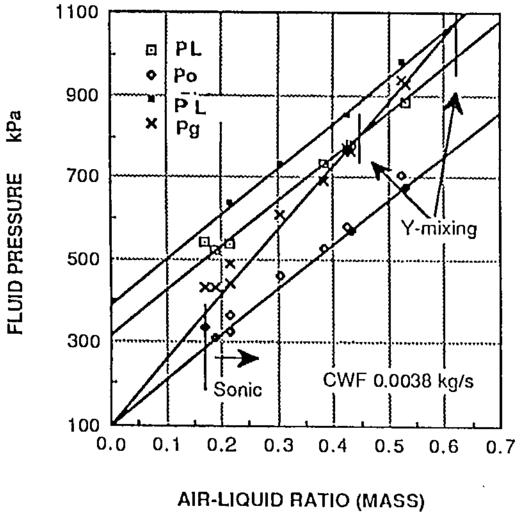

Figure 3 - Fluid Pressures In a Y-Jet Atomizer

A schematic illustration of the Y-mixing, and its preceding co-axial mixing regime at ALR < 0.45 for the Y-jet atomizer is shown in Figure 2. These mixing regimes were identified from the relative values of the liquid and air pressures in the atomizer, and from radial traverses of the spray. Fuel-air mixing is co-axial when the liquid pressure, P_L, exceeds the air pressure, P_g, because the liquid flow at a higher pressure is able to penetrate the air flow in the mixing chamber. In this flow regime, an asymmetric droplet distribution with a high concentration of coarse droplets in one half of the spray cross section was measured. The location and origin of these coarse droplets corresponded to the flow of a thick liquid film in one half of the atomizer mixing chamber and exit port, as shown in Figure 2. When $P_g > P_L$ the flow transition to a mixing regime causes a disappearance of the liquid film in the mixing chamber, and a symmetric and finer spray droplet distribution was measured at the nozzle outlet.

Figure 3 shows a plot of the pressure measurement for the Y-jet CWF atomizer. The data were obtained at a variable air flowrate, and a constant liquid rate of 0.038 kg/s. Two curves are shown for the liquid pressures in Figure 3. These were obtained in repeat experiments, and show that the shear dependent rheology of the CWF incurs a variable pressure loss from viscous flow in the atomizer. The air pressures, P_g, on the other hand are independent of P_L, and fall on an identical curve for the two sets of repeat measurements. In view of the variation in P_L, two different transition points for the Y-mixing regime were identified from the intersection of P_g and P_L. The change-over at ALR > 0.45 was measured for the spray data shown in Figure1, and the second value at ALR > 0.62 was obtained for the repeat experiment. Due to a change in the spray quality with the fuel-air mixing configuration noted above, it is evident that the atomizer performance is affected by the shear dependent rheology and bulk viscosity of the CWF. For the liquid pressures shown in Figure 3, a 20% increase in the viscous pressure loss due to an equivalent change in the CWF bulk viscosity (see Equation 3) requires a 40% increase in the ALR in order to achieve the same flow mixing regime in the atomizer. This example provides a clear and succinct illustration of the variability in nozzle performance, often encountered when atomizing CWFs

An analysis of the pressure terms identified in Figure 2 shows that the following relationship may be written for the liquid pressure in the Y-jet atomizer;

$$P_L = \Delta P_L + \Delta P_M + \Delta P_o \qquad (2)$$

where ΔP_L the pressure drop due to viscous flow in the atomizer is defined by(10);

$$\Delta P_L = \{ 32 \, L \, \mu_s \, m_L / D^2 \rho_L \} \qquad (3)$$

and ΔP_M the pressure loss due to fuel-air mixing in the co-axial regime is defined by(10);

$$\Delta P_M = \{0.5 \, m_g^2 \, f / \rho_g\} + \{\beta \, m_g \, m_L / \rho_g\} \qquad (4)$$

and for Y-mixing ΔP_M becomes;

$$\Delta P_M = \{ \beta \, m_g \, m_L / \rho_g \} \qquad (5)$$

In Equations 3-5, the terms m_g and m_L represent the gas and slurry mass velocities (per unit area), L and D are a characteristic length and diameter of the atomizer, ρ_L is the slurry density, and f and β are pressure drop and velocity coefficients which are determined from experimental measurements. A comparison of Equations 4 and 5 shows that the basic pressure loss in the atomizer mixing chamber is caused by the energy expanded in accelerating the CWF droplets. However, when mixing is co-axial, this pressure loss is supplemented by an additional term which represents frictional losses at the air-liquid interface, and wall losses due to the annular flow of liquid in the mixing chamber(10). Thus, the energy P_o required to atomize the CWF is given by;

$$P_o = \Delta P_M + \Delta P_o \qquad (6)$$

where ΔP_o is the pressure loss at the nozzle exit. Substitution of the LHS terms using Equation 2 yields;

$$P_o = P_L - \Delta P_L \qquad (7)$$

For values of P_L obtained at a constant liquid rate in Figure 3, the intercepts at zero ALR represent, ΔP_L, the viscous pressure loss in the atomizer. Thus P_o may be calculated via Equation 7. Values of P_o obtained in this way are shown in Figure 3, and were found to be independent of the shear dependent rheology and bulk viscosity of the CWF.

Figure 4 shows a plot of the spray droplet diameter as a function of P_o for the Y-jet atomizer. The data shown generally correspond to measurements obtained in the sonic regime, and with co-axial mixing in the atomizer. The droplet diameters are correlated by;

$$(d_{32}/D_o) = 230.9 \, P_o^{-0.78} \qquad (8)$$

Since $P_o = 0.5 \rho_g U_g^2$, Equation 8 may be expressed in terms of the Weber Number (c.f. Equation 1);

$$(d_{32}/D_o) = 17.8 \, We^{-0.78} \qquad (9)$$

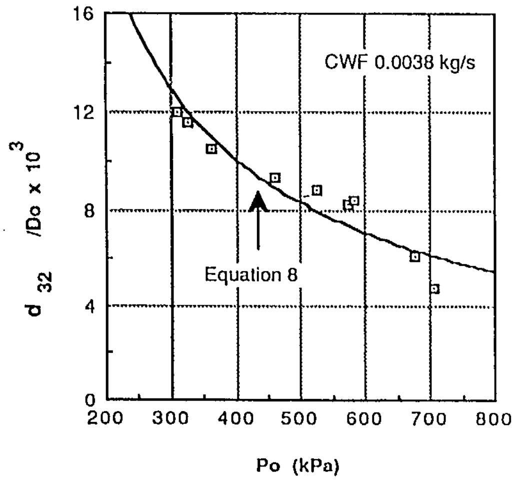

Figure 4 - Spray Droplet Correlation with Co-axial Mixing in a Y-Jet Atomizer

for $\sigma_L = 0.060$ kgs^{-2}. The ability to correlate the droplet diameter with the Weber Number shows good agreement with the atomization theory described previously. A similar correlation, albeit with a different proportionality constant and Weber Number exponent, is also anticipated for the Y-mixing regime. These differences are caused by the lower mixing chamber pressure loss (c.f. Equations 4, 5, 6, 8 and 9) and the improved spray quality obtained in the Y-mixing regime. Thus, the change in the spray quality with the bulk viscosity in the Y-jet atomizer is caused by a transformation in the flow orientation within the atomizer mixing chamber, and not due to the impact of the bulk viscosity in presenting an increased resistance to the *atomization process itself.* References 2, 8, 10 and 11 describe the operating characteristics of a number of different two-fluid CWF atomizers, all of which are in general agreement with the above findings.

COMBUSTION AERODYNAMICS BURNER, DESIGN AND OPERATING PARAMETERS FOR CWFS.

In modern industrial burners, a swirling combustion air jet is used to promote fuel-air mixing, and to improve the ignition stability and combustion intensity of flames. For a low momentum fuel spray, the aerodynamic flow patterns established in the burner near-field mixing zone are shown schematically in Figure 5. Flow mixing induced by the swirling air jet creates a large, torroidal vortex, internal recirculation zone (IRZ) at the flow axis. The fuel spray from the atomizer is typically located within the IRZ, but its trajectory may also partially penetrate the IRZ with an increasing axial and radial distance downstream from the burner mouth. The IRZ basically recirculates hot combustion gases in closed streamlines between two flow stagnation points from the flame tip to its root. However, this flow is not totally isolated, and turbulent diffusion is intense at the flow boundary close to the swirling air jet(12). This exchange of gas promotes mixing which affects the temperature and oxidant concentrations in the IRZ. Over the bulk of the spray trajectory in the IRZ, the recirculating gases provide the aerodynamic drag which reduces the droplet and gas velocities in the fuel spray, the convective heat necessary to promote droplet evaporation and devolatilization, and the ignition energy and oxidant concentration necessary to propagate a flame front.

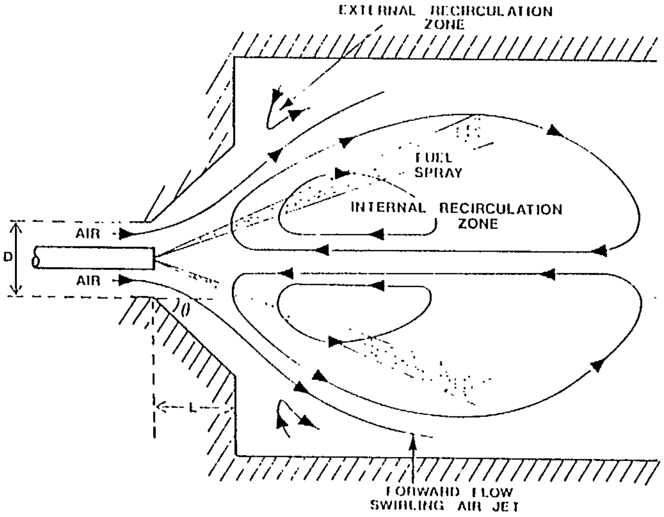

Figure 5 - Flow Mixing in Swirl Burners with Spray Injection

Problems related to flame stabilization with CWFs stem from the longer heating and ignition times of the coal particles and CWF droplets(2). Compared to oil which heats and ignites virtually instantaneously with the first evolution of volatiles, the CWF droplets experience a finite heating and ignition delay due to moisture evaporation and volatiles evolution which occurs at a much slower rate for coals. These problems may be overcome by an increased residence time combined with increased convective heat transfer rates for the drying and ignition of the spray droplets in the IRZ. These requirements are usually achieved by;

i) minimizing momentum penetration of the spray which affects the droplet residence times, and disrupts the flow in the IRZ,

ii) increasing the size and strength of flow recirculation in the IRZ,

iii) decreasing swirl induced mixing or by employing staged combustion to reduce gas dilution and increase the temperature of the recirculating gases in the IRZ.

The impact and improvement of the ignition stability of CWF flames due to the above, and the influence of burner design and operating parameters is illustrated by the following examples.

In pilot-scale, 2.5 MW$_{(th)}$ input, CWF flame trials at the International Flame Research Foundation (IFRF), it was found that the type and spray angle of the two-fluid atomizer used in the burner had a significant impact on the flow patterns established in the IRZ(13). Multi-orifice, two-fluid atomizers of the Y-jet and T-jet type, in which the angular disposition of the outlet holes was varied, produced stable flames with minimal disruption of the flow patterns in the IRZ. For a burner with a divergent quarl of 35° half angle (Figure 5), an optimum atomizer spray angle of 50° provided a trajectory that matched the flow patterns in the IRZ. For these conditions, fuel droplets initially travel through the IRZ, and latter into the forward flow in the swirling combustion air. In this way, the heat to dry and ignite the spray was provided by the recirculating gases in the IRZ. The higher oxygen availability further downstream was then able to sustain combustion.

Employing a similar burner quarl as the IFRF study at a 1.8 $MW_{(th)}$ input scale, investigations with a conical spray 'prefilming' atomizer of a design similar to that described in the next section, revealed that the optimum spray angle was one which maximized initial penetration of the spray close to the IRZ flow boundary(14). Penetration of the spray at this location was found to maximize the residence time in the recirculating gases, and the intense turbulent mixing provided a higher oxygen availability which facilitates rapid flame propagation(2). In contrast to the behaviour of narrower angle sprays, the spray momentum at this location also has a minimal impact in modifying the extent of the induced gas flow patterns established within the IRZ. For CWF, this spray angle of 50° was similar to that identified in the IFRF study. However, the flow patterns for oil using an identical burner and atomizer, required an optimum spray angle that was 10° larger than that used for the CWF. This difference in the spray angle was attributed to the greater momentum penetration and radial dispersion of the heavier and coarser CWF droplets(2,14). This characteristic feature is often ignored when oil-designed burners are modified for CWM combustion.

The flame trials at IFRF also evaluated the effect of burner design and operating parameters such as the L/D ratio and half angle of the divergent quarl, the swirl number and combustion air preheat, and staging on CWM flame stability(13). An increasing L/D ratio and half angle increase flow recirculation and the size of the IRZ(12). Increasing the swirl has the same effect on the IRZ due to a higher negative pressure gradient (suction) that is created at the flow axis. The IFRF study found that a 35° quarl was mandatory for the stable combustion of CWFs containing 30 wt% moisture and 18-36 wt% d.a.f volatile matter. This may be compared with a 25° quarl typically used to sustain stable combustion of oil or high volatile pulverized coals(13). At the optimum quarl angle, a long quarl (L/D = 1.1) as opposed to a shorter one (L/D = 0.7) was found to be necessary for the stable combustion of CWFs made from low volatile coals. The improved ignition stability with increased quarl half angle and length, stems from the increased residence times for CWF droplet heating in the IRZ.

The effect of staged combustion by diverting some of the air normally admitted to the swirling air jet through outer tertiary air ports has been evaluated(13). Increased staging, increased temperatures uniformly in the swirling jet and the IRZ. However, the increased temperatures and flame stability with reduced gas dilution was off set by poorer carbon burnout, due to a reduced oxygen availability in the early stages of combustion. Higher swirl numbers relative to those used in unstaged flames, tended to improve carbon burnout by improved mixing and a higher oxygen availability, but this reduced the IRZ temperatures and the flame stability.

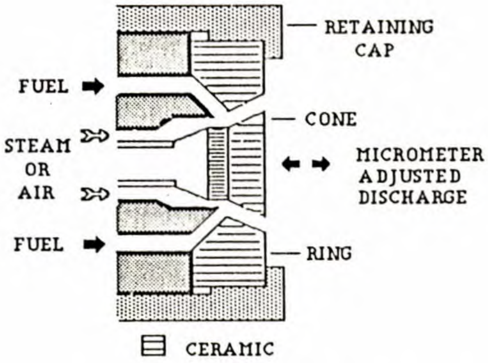

Figure 6 - Schematic of the NRC CWF-Oil Dual Fuel Atomizer

In view of the trade-off between flame stability and carbon burnout, staging is marginally beneficial as a design tool. A review of the operating characteristics of swirl burners, particularly pulverized coal burners, showed that the increased quarl dimensions played a more effective role in increasing the size of the IRZ, while maintaining high gas temperatures(2). This occurs because the increased dimensions of the quarl are accompanied by lower rates of mixing between streams in the near-field zone, compared to those attained when the swirl number is increased. The IFRF study has also shown that high swirl numbers are not an effective tool to improve the ignition stability of CWF flames due to a tendency to decrease the temperature of the recirculating gases in the IRZ by increased gas dilution(13).

DUAL FUEL BURNER DEVELOPMENT FOR FRONT WALL FIRING.

Figure 6 shows a schematic diagram of the spray head of the 16 $MW_{(th)}$, National Research Council (NRC) dual fuel (CWF/Oil) two-fluid atomizer. An outer annulus develops the CWF into a thin liquid sheet which is brought into contact with the atomizing fluid at sonic velocity. A wear resistant ceramic cone and matching ring forms the final discharge annulus or mixing chamber, where the aerodynamic and hydrodynamic pressures are controlled to yield a spray of fine droplets. The ceramic components are selected to reduce erosion of the mixing chamber dimensions which would otherwise result in a rapidly deteriorating spray quality. The angle of the mixing chamber relative to the axis of the nozzle determines the spray angle of the atomizer. Different spray angles by replacing the ring and cone are often used in field trials to optimize the spray trajectory, and hence the ignition stability and compactness of the flames. As outlined previously, the optimum spray angles may also differ for CWF and Oil combustion.

The atomizer discharge area is adjustable, and is controlled by an external micrometer with low and high gap settings on a graduated scale. This adjustable feature permits fine tuning of the nozzle to maintain throughput, sonic discharge velocities and a spray quality independent of the variable shear dependent rheology of the CWF. The latter avoids difficulties due to changes in the flow mixing regimes

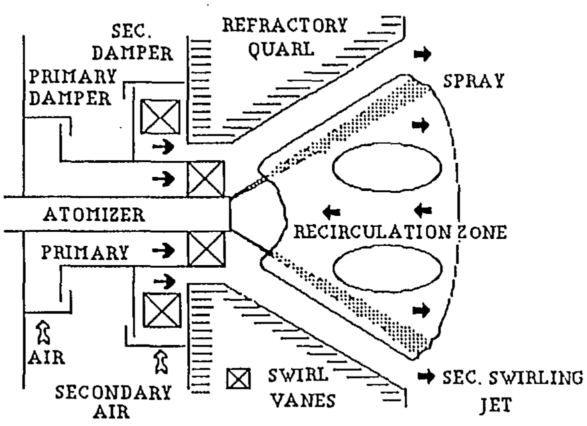

Figure 7 - Schematic of the CANMET CWF Burner Register and Aerodynamic Flow Mixing

similar to that described earlier for the fixed geometry Y-jet atomizer. Thus, the nozzle adjustment essentially provides a method of controlling the aerodynamic and hydrodynamic pressure ratio in the mixing chamber. The same adjustable feature also permits a convenient means of fuel switching to oil, by closing down the discharge gap. The latter reduction is necessary due to large differences in the viscosity of oil and CWF, which would otherwise cause a higher oil throughput to the burner during fuel switching.

The schematic in Figure 6 shows that the mixing chamber is essentially an annular Y-jet design. The major difference between this and the circular orifice Y-jet design described previously, is that the annular configuration offers a significantly larger mixing volume. Using the present $16\text{MW}_{(th)}$ atomizer as a basis, the annular design is roughly comparable in volume to 100 circular Y-jets of a more conventional design. The greater volume, and hence surface area, is thus beneficial for the primary separation of coal particles from the liquid surface during fuel atomization. An additional benefit of the annular design is that it develops a hollow cone spray discharge with an induced recirculation of fine droplets and particles at the spray axis. This pattern is compatible with the recirculation flow also established in the IRZ. The presence in the flame core of fine droplets and particles that heat and ignite more rapidly are generally beneficial to the overall ignition stability of the flame.

Figure 7 shows a schematic illustration of the Canada Centre for Mineral and Energy Technology (CANMET) burner register. The burner design comprises of two parts; a mechanical register assembly of swirl vanes, flow separation ducts and control dampers, and a refractory quarl. The burner register is basically configured to generate two concentric primary and secondary swirling air jets, with independent control of the swirl level and mass flow in the respective streams. The latter feature provides a method of sustaining different gas dilution and mixing intensities in the IRZ, for the stable ignition and combustion of CWF and Oil which differ significantly in their chemical reactivity. As outlined in the section on combustion aerodynamics, lower swirl levels and mass flows are generally employed in the primary air flow during CWF combustion. Critical quarl design parameters in accordance with the guide-lines mentioned previously are also maintained for CWF combustion. The NRC atomizer is located in a central guide tube in the register, and final flame shaping and ignition stability is achieved by adjustment of the register settings in combination with the atomizer spray angle and the nozzle outlet gap settings.

The above atomizer and burner register combination was demonstrated on CWF and Oil during summer 1987 in the Unit No. 10, oil-designed utility boiler at the Maritime Electric Company's, Charlottetown Generating Plant. The prototype was developed and tested at its 16 $\text{MW}_{(th)}$ design rating on CWF, but an upper limit of 20 $\text{MW}_{(th)}$ and a lower limit of 10 $\text{MW}_{(th)}$ was also demonstrated. These results demonstrate a 2:1 turn-down ratio without loss of flame stability or deterioration in combustion efficiency due to poor atomization. The latter was confirmed by the noticeable absence of sparklers in the flame, or any significant drop-out of large unburnt fuel aggregates in the furnace bottom. Fly ash samples recovered from the boiler indicated a 96 % fuel burnout efficiency. However, due to mixed firing with oil in a boiler which was operating at 40% MCR, it is thought that this efficiency is a conservative estimate of the actual burnout efficiency. The difficulty in estimating the actual burner performance stems from the oil-carbon contamination of the coal flyash. The best comparable performance test with the 5 commercial CWF burners at 93% MCR in the same boiler indicate a fuel burnout efficiency of 93%. In addition to the lower combustion efficiency, the commercial CWF burners showed poor turn-down stability. The oil combustion tests on the CANMET/NRC burner demonstrated an 8:1 turn-down ratio, but higher firing rates beyond the 16 $\text{MW}_{(th)}$ design capacity were limited by poor oxygen availability in the flame. The latter is anticipated due to the lower rates of mixing and gas dilution in the IRZ that is a feature of the different quarl design employed in the burner.

The prototype versions of the NRC atomizer used alumina ceramics as a wear resistant component for the cone and ring assembly(15). Field experience with the NRC atomizer has shown that the high erosion resistance was compromised by poor thermal shock and toughness of alumina. While ceramic components as a class are known for their extreme hardness (erosion resistance), the severe high velocity, sonic conditions and the abrasive coal and ash particles, present an environment that few materials are able to withstand. Silicon nitride ceramics due to their improved thermal shock resistance were tested in the current burner program, but had an erosion life of less than 500 h. Partialy stabilized zirconia and zirconia toughened alumina are candidate materials that will be evaluated in future tests for their improved erosion resistance.

UTILITY AND INDUSTRIAL CWF AND BURNER DEMONSTRATION PROGRAMS

The CANMET/NRC burners will be tested in a full, 5 burner conversion in the Unit 10, boiler at the Charlottetown Generating plant in the summer of 1988. The purpose of this trial is to demonstrate burner and boiler performance on CWF. Most of the large utility CWF demonstrations to date while positive on the lack of ash induced erosion or capacity reductions, have turned in poor combustion efficiencies and burner performance characteristics on CWFs. Reliability from the latter perspective is a primary consideration which will be addressed in the 1300 tonne CWF combustion test and boiler performance evaluation.

A similarly sized burner is also a key component of an industrial steam package boiler conversion at the Minas Basin Pulp and Power Co., Hantsport, Nova Scotia. Project commissioning is anticipated in the spring of 1988, for a two year CWF demonstration program that will be operated on a commercial basis. This program will provide a greater opportunity to evaluate materials for atomizer wear resistance, and the long term impact on boiler performance, the environment and the commercial viability of the fuel. The latter will be linked to parallel studies to identify and test CWFs made with cheaper chemical additives and coal feedstocks.

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