

RESOURCES OF SOLID BIO-FUEL IN THE CENTRAL URALS AND PROCESSING VARIANTS

A case for using locally made wood chips as biomass fuel

**FOREST PRODUCTS SOCIETY CONFERENCE OCTOBER 2015
“WOOD-BASED ENERGY GOES GLOBAL”
PART OF
ADRIATIC WOOD DAYS 2015, DUBROVNIK**

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A quote from Dr. Charles D.Ray*

- RECOGNIZE THAT BIOMASS PROCESSING FOR ENERGY PRODUCTION ON DISTANT SHORES IS INEFFICIENT AND AT SOME POINT DRIVES UP THE RAW MATERIAL COST FOR LOCAL FOREST INDUSTRIES.
- PROMOTE, THROUGH EDUCATION, THE USE OF FIREWOOD, WOOD PELLETS, AND, IN COMMUNITIES WITH DENSE POPULATIONS IN FORESTED AREAS, **WOOD CHIPS** FOR RESIDENTIAL AND LIGHT INDUSTRIAL HEATING.

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THE THRUST OF THIS RESEARCH

- THE USE OF WOOD PELLETS AND BRIQUETTES AS BIOMASS FUEL MIXED WITH COAL IS OF GROWING IMPORTANCE:
 - PROJECTS IN THE UK BASED ON AMERICAN WOOD
 - OBJECTIVE IS TO REDUCE CARBON DIOXIDE EMISSION
- DOUBTS EXPRESSED ABOUT THE ECONOMICS OF MAKING PELLETS AND BRIQUETTES FOR USE FAR FROM THE SOURCE
- YURI YURIEV'S WORK FOCUSES ON THE TECHNIQUES FOR DRYING (OR "SEASONING") WOOD DEBRIS PRODUCED IN THE FOREST WHERE THE TIMBER IS FELLED AND "BUCKED", I.E. SAWN INTO LOGS (BOTH ROUND AND SHAPED)

THE URAL CONTEXT FOR THIS RESEARCH

- IN THIS PAPER THE POSSIBILITY IS DEMONSTRATED OF INCORPORATING WOOD TO 40% OF THE FUEL POWER BOILERS OPERATING ON BITUMINOUS COAL
- THIS PROBLEM IS URGENT FOR THE URAL REGION, WHERE MANY BOILERS USE BITUMINOUS COAL, WHILE LOCATED CLOSE TO SOURCES OF WOOD DEBRIS
- THIS IS WITHOUT HIGH ADDITIONAL EXPENDITURES FOR RECONSTRUCTION OF THE BOILERS
- MODEST MODIFICATION OF THE BOILERS ALLOWS INCORPORATION OF WOOD BIO-FUEL PARTIALLY DRIED TO A MOISTURE CONTENT OF 20%.

IN CONTRAST, PELLET PRODUCTION REQUIRES CRUSHING AND DRYING OF WOOD TO A MUCH LOWER MOISTURE CONTENT TO REACH THE REQUIRED PRODUCT STRENGTH

FOREST EXPLOITATION

TWO PRINCIPLES LIE BEHIND THE APPROACH RECOMMENDED FOR THE URAL REGION:

- DO NOT CLEAR THE FELLING AREA BUT LEAVE MUCH OF THE DEBRIS, ESPECIALLY SMALL BRANCHES AND GREEN MATERIAL, ON THE FOREST FLOOR TO MAINTAIN THE HUMUS CONTENT
- DO NOT ATTEMPT TO PRODUCE ONLY MERCHANTABLE WOOD, BUT CONCENTRATE ON HIGHER VALUE WOOD AND USE THE REST FOR BIO-FUEL

SOURCE OF THE WOOD DEBRIS

THE FOLLOWING ARE IDENTIFIED AS BETTER USED FOR BIO-FUEL THAN AS MERCHANTABLE WOOD:

- SOFT-WOODED BROADLEAVED SPECIES WITH SMALL-SIZED AND MEDIUM-SIZED DIAMETER(8-20 CM)
- BUCKING DEBRIS
- DEBRIS FROM FURTHER PROCESSING

THIS RESEARCH SHOWS THAT THE URAL FOREST AREA COULD USE THE ABOVE TO PRODUCE 2,500 MW OF POWER.

WOODCHIP YIELD FROM A TYPICAL URAL SITE

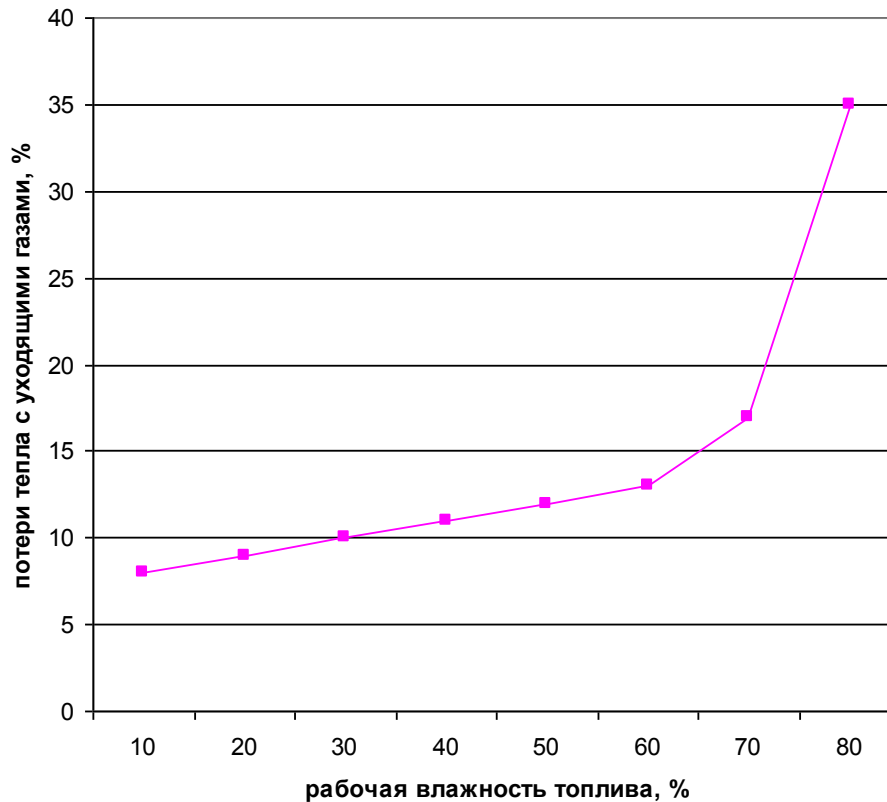
- THE RESEARCH SHOWS IN GREAT DETAIL THE YIELD OF MERCHANTABLE WOOD AND DEBRIS FROM A TYPICAL URAL FELLING SITE (SEE WRITTEN VERSION OF THE PAPER)
- IT IS CONCLUDED THAT IT IS NOT RATIONAL TO PRODUCE A FULL ASSORTMENT OF MERCHANTABLE WOOD
- THE RECOMMENDATION IS TO REDUCE DRASTICALLY THE ASSORTMENT AND TO CONVERT THE LOW-VALUE WOOD AND DEBRIS TO BIO-FUEL

DRYING OF BIO-FUEL

- SINCE WOODCHIPS HAVE A NATURAL MOISTURE CONTENT OF 40-45%, DRYING (OR SEASONING) IS NEEDED BEFORE USE AS BIO-FUEL
- DRYING TO 20-24% IS RELATIVELY SIMPLE
- DRYING TO AROUND 10%, AS REQUIRED FOR PELLETS, INVOLVES THE PORE-DIFFUSION PHASE, AND THE RATE OF DRYING DRAMATICALLY DECREASES

THE FOLLOWING DIAGRAM SHOWS WHY DRYING TO ABOUT 20% FOR WOODCHIPS IS FAVOURABLE

HEAT LOSS VIA EXIT GASES VERSUS WOOD FUEL OPERATING HUMIDITY



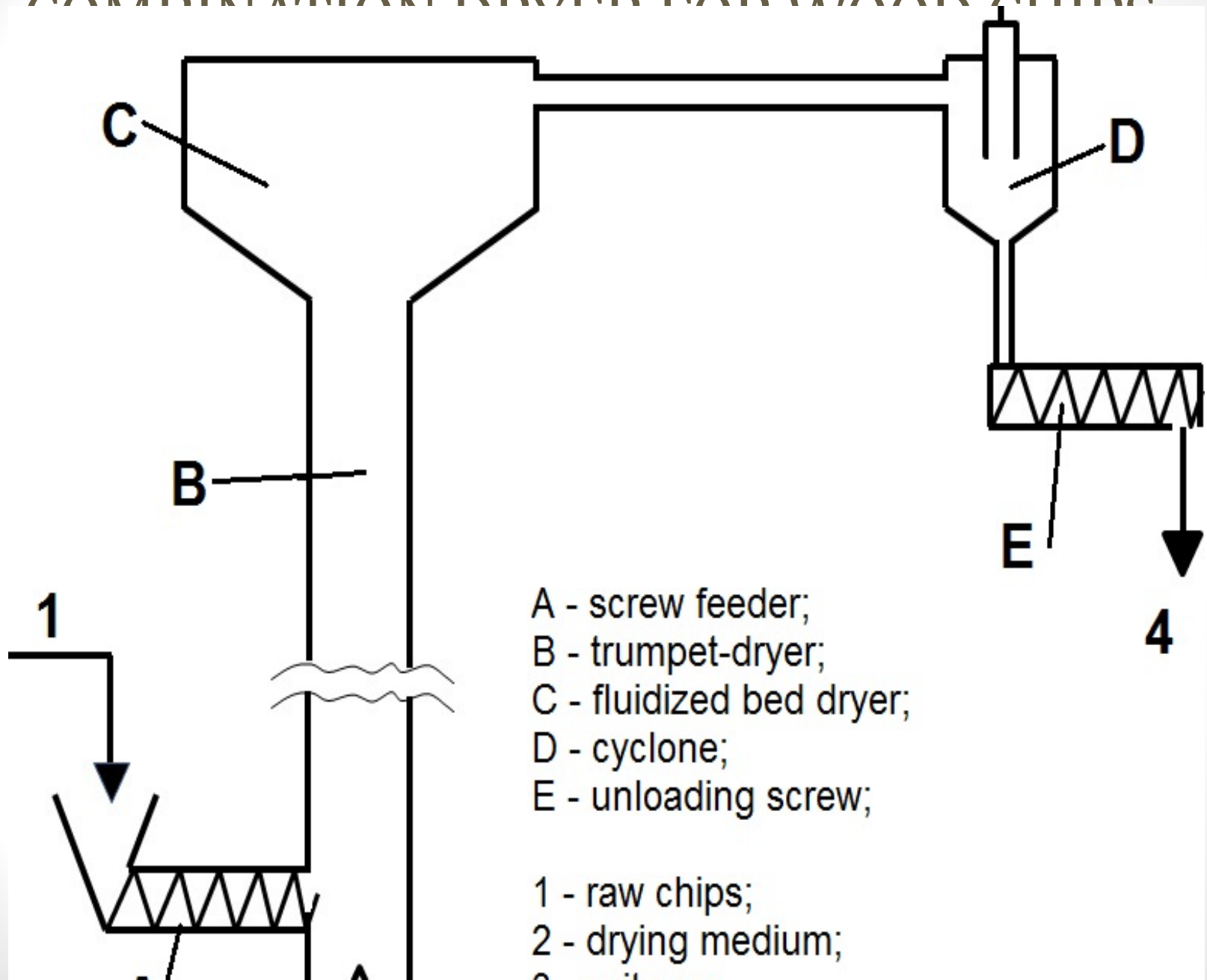
TYPE OF DRYER

- IN THIS RESEARCH TUBE AND FLASH DRYERS WERE BOTH TESTED ON WOODCHIPS
 - TUBE DRYERS PROVED EFFICIENT AT REMOVING SURFACE MOISTURE
 - FLASH DRYERS PROVED BETTER AT PORE DIFFUSION
- COMBINING THE TWO TECHNIQUES PROVED TO BE FASTER AND MORE EFFICIENT (SEE NEXT SLIDE)

COMPARISON OF DRYER TYPES FOR WOODCHIPS

DRYER TYPE	SPECIFIC MOISTURE REMOVAL kg/m ³ .h	DRYER VOLUME m ³	LENGTH m	DIAMETER m
TUBE	80	2.43	34	0.4
FLASH	120	1.62	8.5	0.35
COMBINED	240/80	0.65/0.48	9.2/2.5	0.4/0.4

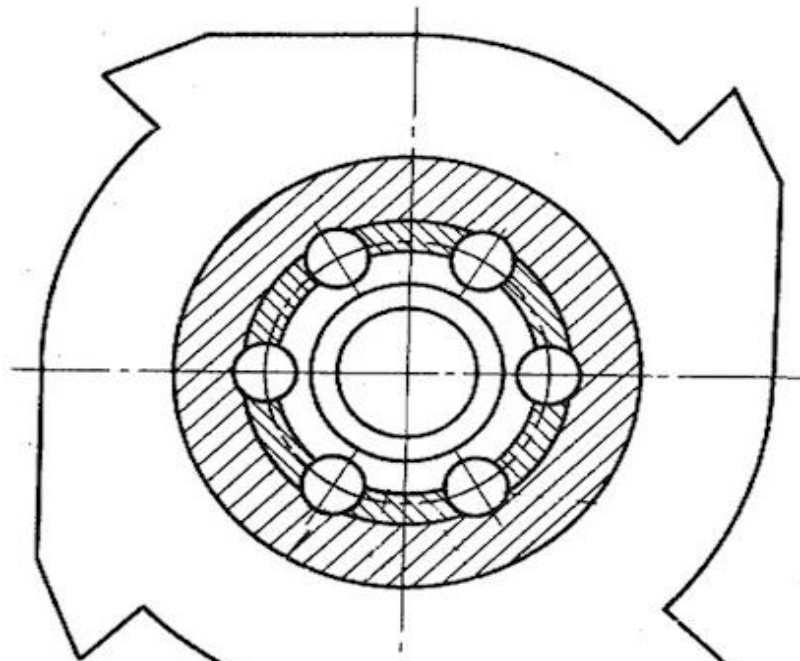
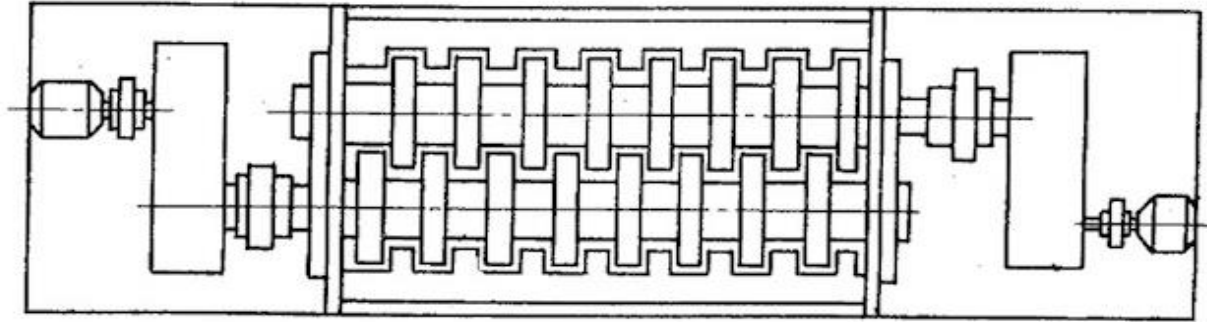
COMBINATION DRYER FOR WOOD CHIPS



- A - screw feeder;
- B - trumpet-dryer;
- C - fluidized bed dryer;
- D - cyclone;
- E - unloading screw;

- 1 - raw chips;
- 2 - drying medium;
- 3 - air;
- 4 - dried chips;

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RESEARCH CONCLUSIONS

- THE WOOD BIOFUEL AVAILABLE IN THE CENTRAL URAL CAN PROVIDE POWER OF 2500 MW.
- FOR SMALL ENTERPRISES IT IS MORE EFFICIENT TO TRANSPORT THE CHIPS PREPARED IN THE HARVESTING AREA.
- IF WOODCHIPS CAN BE USED LOCALLY, THEY ARE MORE ECONOMICAL AS FUEL IN CHIP FORM (MIXED WITH COAL) THAN CONVERTED TO PELLETS OR BRIQUETTES.
- THE OPTIMUM MOISTURE CONTENT BEFORE COMBUSTION IS 20 - 25% FOR CHIPS VS. 5-10% FOR BRIQUETTES AND PELLETS
- A COMBINED DRYER (TUBE AND FLASH) HAS A HIGHER INDEX OF SPECIFIC MOISTURE REMOVAL THAN SINGLE-TYPE DRYERS

POSTSCRIPT ON FURTHER RESEARCH

- IN THE PAPER THE RELATIVE EFFECTIVENESS OF THE COMBUSTION OF THE SPECIFIC FORMS OF WOOD FUEL IS **NOT** EXAMINED
- THIS THEME WILL BE THE TOPIC OF A SEPARATE ARTICLE
- TO ESTIMATE THE EFFECTIVENESS OF USING WOOD DEBRIS FOR FUEL, THE LEVEL OF PRICES FOR THE RAW MATERIAL IN THE SPECIFIC REGION MUST BE KNOWN, ALONG WITH COSTS FOR THE PREPARATION OF THE BIO-FUEL
- WE HAVE INITIAL DATA FOR THIS FUTURE ARTICLE