Al-Ghazal
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The Modern Flour Mills & Macaroni Factories Co. Ltd

Pasta Solutions

from

Pasta Producers

PASTA PRODUCTION QUALITY PARAMETERS

A “REAL-WORLD” PRACTICAL GUIDE TO PASTA PRODUCTION

NICOLAS T. TSIKHLAKIS

The Modern Flour Mills and Macaroni Factories Co.

"CORE" TECHNOLOGY OVER THE PAST 20 YEARS HAS REMAINED UNCHANGED

- IMMENSE ADVANCES IN CONTROL SYSTEMS
- DRAMATIC IMPROVEMENT IN LINE EFFICIENCIES
- DRAMATIC INCREASE IN LINE CAPACITIES
- DECREASE IN DRYING TIMES (IN MASS PRODUCTION APPLICATIONS)
- HOWEVER THE "SCIENCE" REMAINS UNCHANGED

QUALITY BENCHMARKS

FUNDAMENTAL PASTA REQUIREMENTS

- COLOR: BRIGHT, YELLOWISH, FREE OF DISCOLORATION
- SMELL & TASTE: FREE OF “OFF” CHARACTERISTICS
- ROBUST COOKING RESISTENCE, NO SUPERFICIAL STICKINESS
- PASTA SHOULD NOT BECOME EXCESSIVELY SOFT AFTER COOKING, IT SHOULD MAINTAIN ITS “BODY” AND BITE.
- PASTA SHOULD NOT LUMP TOGETHER
- COOKING LOSS SHOULD NOT EXCEED 4-6% DEPENDING ON THE TYPE OF PASTA (RELATED TO SURFACE AREA)
- THE REMAINING COOKING WATER SHOULD STILL RETAIN ITS ORIGINAL CLARITY (OR CLOSE TO IT)
- SPECKS: Brown and black spots.

QUALITY BENCHMARKS

FUNDAMENTAL PASTA REQUIREMENTS

- COOKING LOSS & COOKING GAIN LABORATORY ANALYSIS IS NOT ALWAYS A GOOD INDICATOR OF PASTA QUALITY
- EXCESS STARCH LOSS (POSSIBLY DUE TO EXCECSSIVE STARCH DAMAGE) DOES NOT ALWAYS SHOW UP IN TESTS
- “FREE STARCH MAY STICK TO THE SURFACE OF THE PASTA AND NOT RELEASE IN WATER THUS SKEWING THE TESTS

COOKING LOSS TESTED AT 6%, YET QUALITY IS UNACCEPTABLE

INGREDIENTS

- GLOBAL STANDARD REMAINS DURUM
- THE “COMMODITIZATION” OF PASTA HAS LED TO A HUGE INCREASE IN DEMAND FOR CHEAP PASTA
- WHEAT FLOUR-BASED PASTA PRODUCTION IS GROWING RAPIDLY, PARTICULARLY IN THE DEVELOPING WORLD
- QUALITY REQUIREMENTS HAVE CHANGED

QUALITY BENCHMARKS

FUNDAMENTAL RAW MATERIAL REQUIREMENTS

PARAMETER	WHEAT FLOUR	DURUM SEMOLINA
PROTEIN % (D.B.)	MIN 10.5-11	MIN 12.5-13
WET GLUTEN	MIN 24-26%	MIN 32-35%
ASH	.5-.55	.7-.9
GRANULATION	150-200µ	180-300µ=80%
MOISTURE	14% MAX	14% MAX
COLOR	WHITE/FREE OF BRAN	L=83-85 b=27-28

QUALITY BENCHMARKS

FUNDAMENTAL RAW MATERIAL REQUIREMENTS

- STARCH DAMAGE IS ABSOLUTELY CRITICAL
- EXCESSIVE STARCH DAMAGE IS DISASTROUS
- AMYLOSE DISPERSION
- IT CAN BE ARGUED THAT STARCH DAMAGE IS MORE IMPORTANT THAN PROTEIN (SULPHYDRILIC BONDING IS CRITICAL) HOWEVER EVEN A STRONG PROTEIN NETWORK CAN NOT OVERCOME THE EFFECT OF STARCH DAMAGE
- STARCH-PROTEIN COMPLEX “QUALITY” ALSO DEPENDS HEAVILY ON THE PROTEIN LEVELS. LESS PROTEIN=GREATER STARCH RELEASE
- GRANULES OF PURE STARCH ARE INSOLUBLE IN WATER AND REMAIN INTACT AND ABSORB WATER WHEN HEATED.
- IT IS IMPORTANT TO FORM THE STARCH-PROTEIN COMPLEX PRIOR TO THE COMPLETE GELATINIZATION OF STARCH

QUALITY BENCHMARKS

FUNDAMENTAL RAW MATERIAL REQUIREMENTS

- Atash Peykar Farzaneh*, Eyvazzadeh Orang and Berenji Shila Of the Islamic Azad University, Varamin Branch, Iran, in their close look at starch damage and its effect on short cut pasta quality concluded that the optimal starch damage is 15%.
- Results obtained by (Dexter et al., 1994) also stated that the damaged starch had positive correlation with cooking and cooking loss increased with increasing damaged starch percentage. The overall results showed that increasing damaged starch level in pasta caused an increase in the Solid content in the cooking water and cooking number with a decrease in consumer acceptance ($p<0.05$

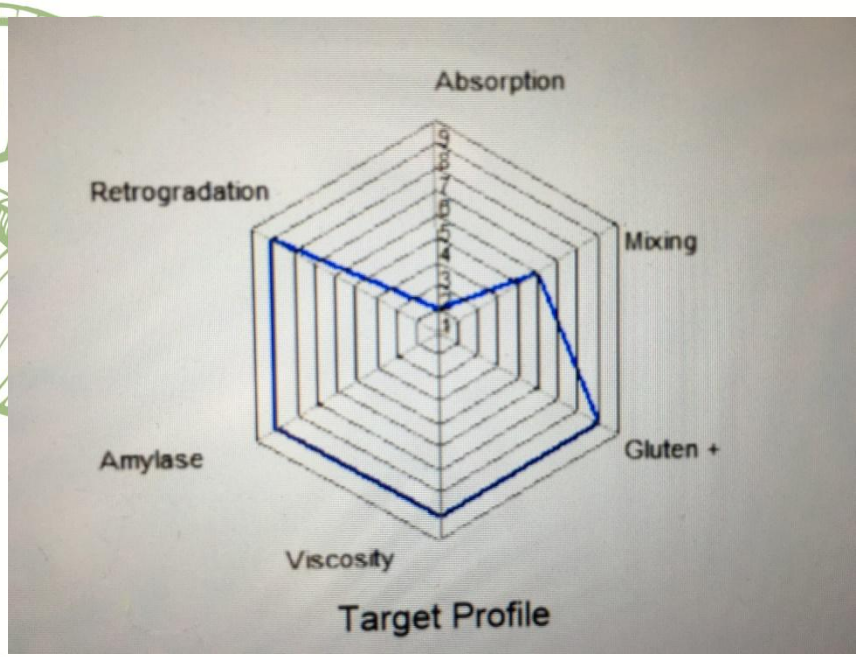
QUALITY BENCHMARKS

FUNDAMENTAL RAW MATERIAL REQUIREMENTS

- PROTEIN LEVELS ALONE ARE NOT AN ADEQUATE INDICATOR
- PROTEIN QUALITY IS EQUALLY IF NOT MORE IMPORTANT
- RHEOLOGICAL CHARACTERISTICS ARE CRITICAL

QUALITY BENCHMARKS

FUNDAMENTAL RAW MATERIAL REQUIREMENTS

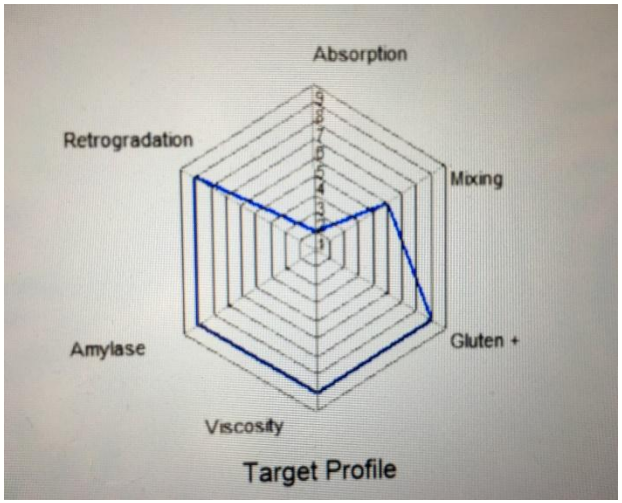


- MIXOLAB ANALYSIS OF DURUM SEMOLINA
- GOOD CHARACTERISTICS
- GOOD TOLERANCE TO MIXING
- GOOD TOLERANCE TO HEAT
- WET GLUTEN=32%

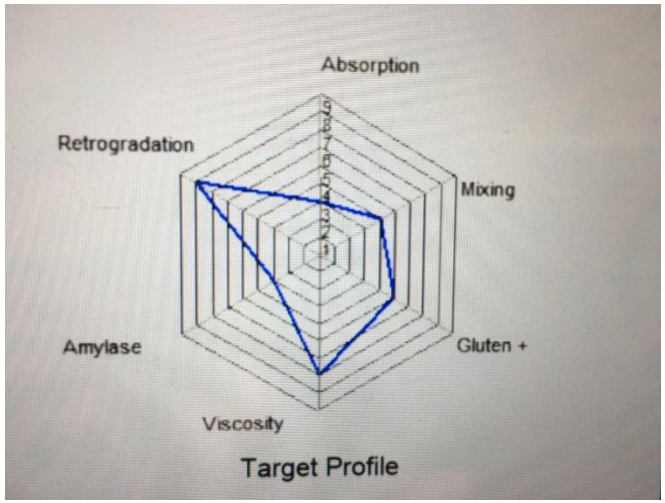
QUALITY BENCHMARKS

PROTEIN QUANTITY VS. QUALITY

32% WET GLUTEN

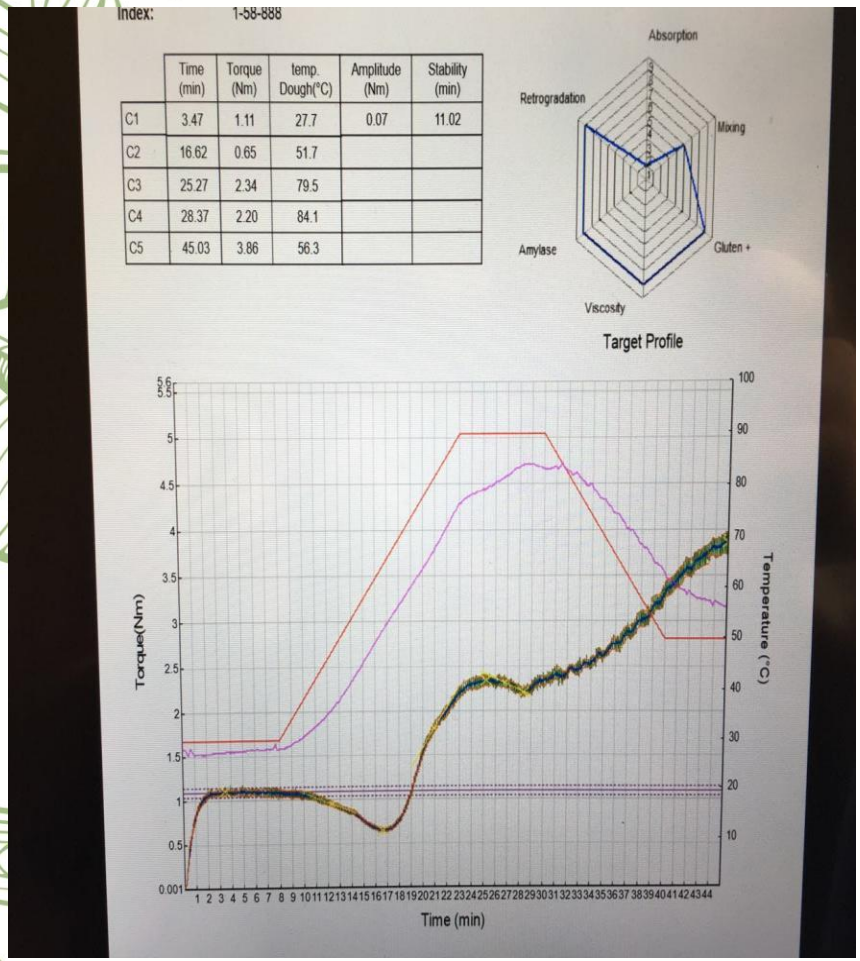


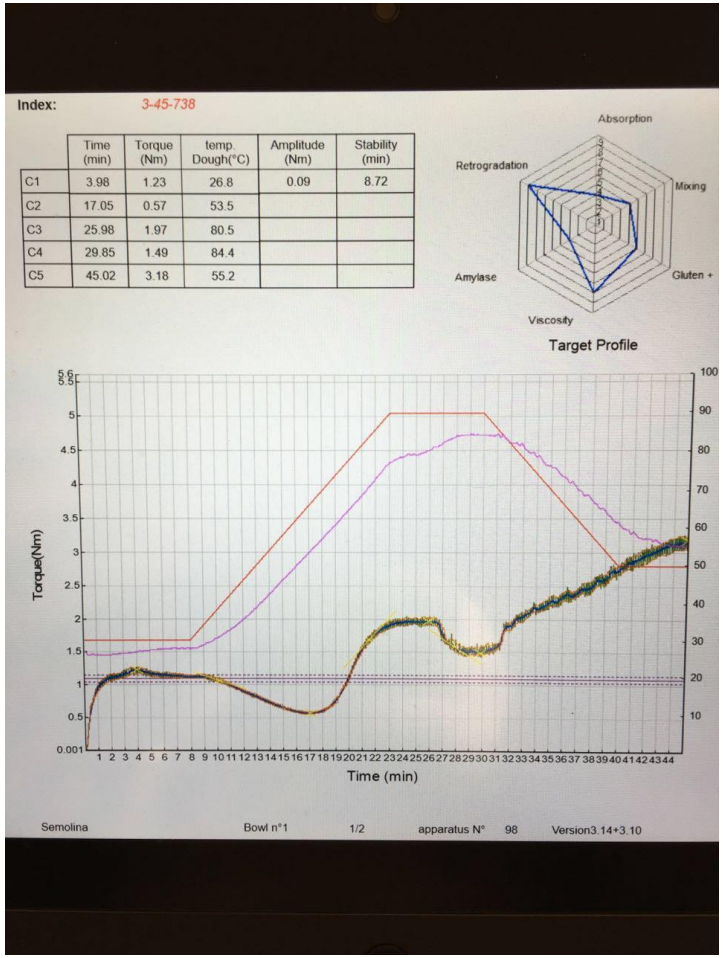
35% WET GLUTEN



QUALITY BENCHMARKS

PROTEIN QUANTITY VS. QUALITY





MFM - Custom Ingredient Solutions

QUALITY BENCHMARKS

PROTEIN QUANTITY VS. QUALITY

DIFFERENCE BETWEEN THE TWO SAMPLES SHOW EVIDENCE THAT SAMPLE 2, ALTHOUGH HIGHER IN GLUTEN, SHOWS EVIDENCE OF STARCH DAMAGE, AND AS SUCH IS INFERIOR

- HIGHER ABSORPTION LEVELS
- LOWER GLUTEN + INDEX (LOWER HEAT RESISTENCE C3-C4),
- ELEVATED C2 –PROTEIN weakening as a function of mechanical work and temperature

QUALITY BENCHMARKS

PROTEIN QUANTITY VS. QUALITY

- MIXOLAB INDEX 1-58-888
- TYPICAL DURUM WA BEHAVIOUR (LOW)
- LOWER HYDRATION LEVELS(1)
- MEDIUM VALUES FOR MIXING BEHAVIOUR
- HIGH GLUTEN + INDEX (HIGH RESISTENCE TO HEATING)
- HIGH AMYLOLYSIS INDEX (LOW AMYLASE ACTIVITY)

QUALITY BENCHMARKS

PROTEIN QUANTITY VS. QUALITY

RHEOLOGICAL DATA

Alveo Figures

- p/l value from .8-2=Flour is suitable for Pasta
- P/L value less than .5 = Flour is too weak and unsuitable
- W= 250-280

Milatovic & Mondelli-LA TECHNOLOGIA DELLA PASTA ALIMENTARE

QUALITY BENCHMARKS

GRANULATION

TYPICAL DURUM SEMOLINA GRANULATION PARAMETERS

GRANULATION IN µ	%
Over 450	6
350-450	10.5
250-320	40.7
195-250	30.8
125-195	12

QUALITY BENCHMARKS

GRANULATION

BREAD/PASTA FLOUR GRANULATION PARAMETERS

GRANULATION IN µ	%
250-320	.6
220-250	.7
195-220	10.3
146-195	20.8
125-146	50.7
THRU 125	16.1

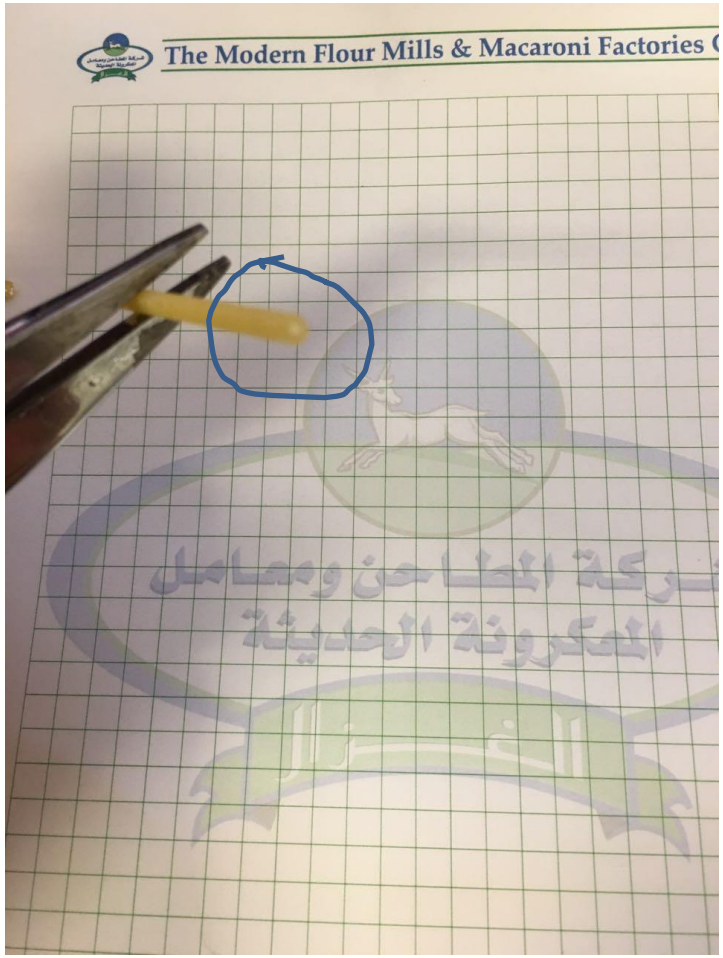
QUALITY BENCHMARKS
GRANULATION

KEY CONSIDERATIONS

- COARSE SEMOLINA IS NOT SUITABLE DUE TO THE HIGHER HYDRATION TIMES REQUIRED.
- STANDARD MIXING TIMES OF 12-15min NOT ENOUGH
- THEORETICALLY, KEY CONDIDERATION WHEN BLENDING SEMOLINA + FLOUR IS TO MAINTAIN CONSIDERABLE UNIFORMITY IN GRANULATION
- IN PRACTICE BLENDS OF SEMOLINA AND FLOUR ARE POSSIBLE (WHILE MAINTAINING GOOD PASTA QUALITY WITH REASONABLE COOKING PROPERTIES)
- KEY ISSUE IS DIFFERENT HYDRATION TIMES REQUIRED AT DIFFERENT GRANULATION LEVELS
- WHEN BLENDING, IF SEMOLINA IS TOO COARSE, IT WILL RESULT IN WHITE (DRY RM) POCKETS IN THE PASTA, WHICH HAS NOT BEEN HYDRATED.

QUALITY BENCHMARKS

GRANULATION



PROCESSING

DOUGH STAGES

PROCESS STEP	KEY "EFFECTS"
DRY+WET INGREDIENTS DOSING	(a) TURBO MIXING CRITICAL (b) PROPER DOSING AT PREMIX LEVEL WILL YIELD TO LESS DUST CREATION IN THE VESSEL, AND AS SUCH LESS PROBLEMS WITH THE VACUUM PUMPS. (IN ADDITION TO LEVEL SENSOR ISSUES)
MIXING STAGE DOUGH WATER TEMP: 30-35C DOUGH TEMP: 40-42C 12-15min STANDARD MIXING	(a) DOUGH HYDRATION (b) OXIDATION (EVEN AT VACUUM) (c) LIPID PROTEIN INTERACTION INITIATED (d) ENZYMATIC ACTIVITY INITIATED (e) PARTIAL GLUTEN DEVELOPMENT (f) STARCH-PROTEIN COMPLEX INITIATION (g) DAMAGED STARCH INITIATES WATER ABSORPTION
EXTRUSION STAGE HEAD PRESSURE: 105-120 HEAD TEMP: 40C CYLINDER TEMP: 30C	PARTIAL PROTEIN DENATURATION (MECHANICAL STRESS)

PROCESSING

DRYING PARAMETERS

Traditional vs. HT vs. VHT Drying Tech

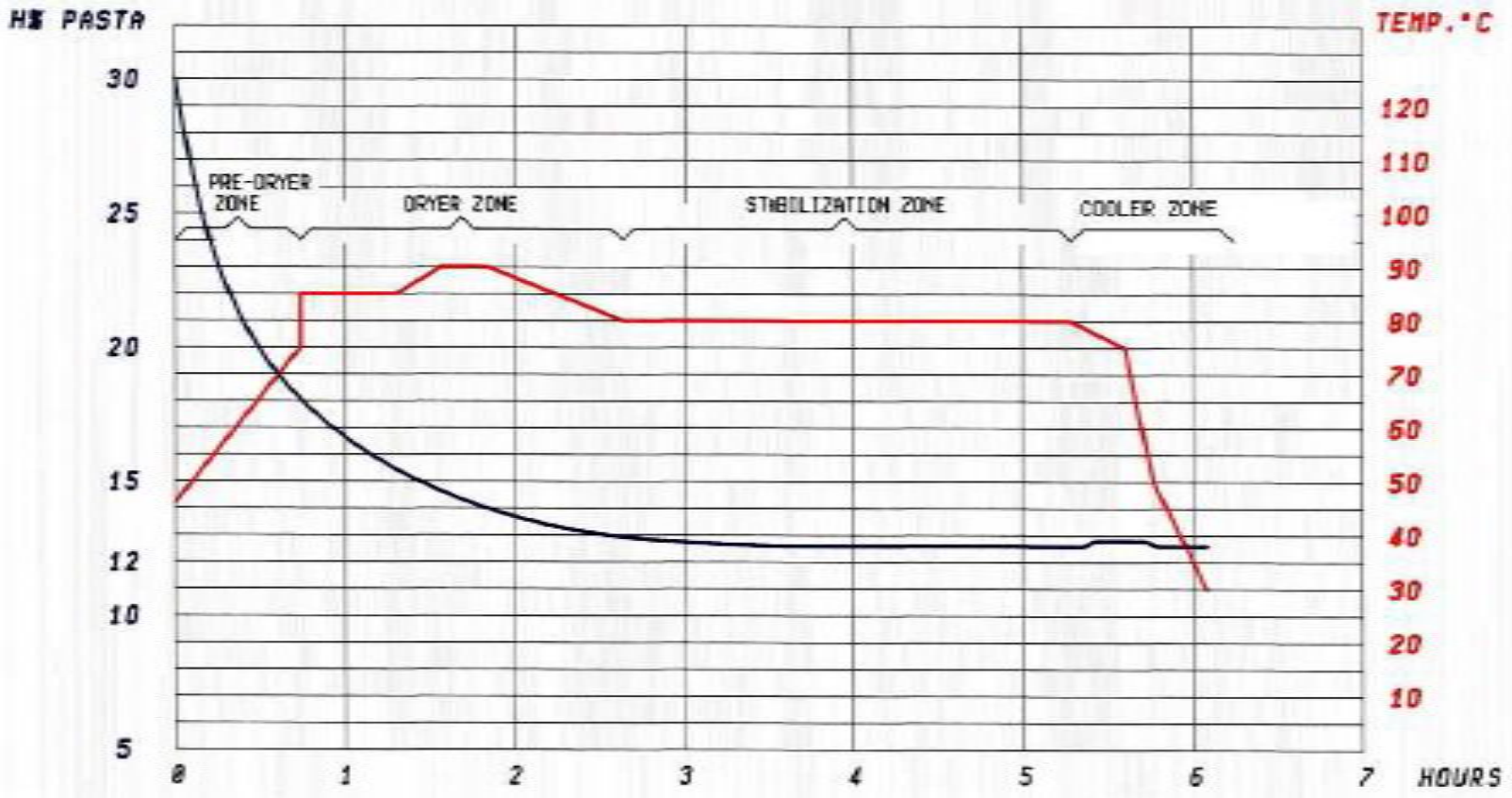
DRYING TECH	BASIC PARAMETERS
TRADITIONAL	• ALLOWS FOR FLOUR-SEMOLINA/SEMOLATO BLENDS • MIXING TIMES OF 25-30MIN REQUIRED • 3 STAGE DRYING, TOTAL 40hrs • PRE DRYER: CIRCA 50C-4HRS • DRYER: CIRCA 40C-32HRS
HT-HIGH TEMPERATURE	• 2 STAGE PREDRYING (55C-80C • 3 PHASE DRYING (65C-80C DOWN TO CIRCA 35 AT STABILIZATION
VHT-VERY HIGH TEMPERATURE	• PREDRYING: 80-95C • TEMPS MAY REACH UP TO 105+ FOR SHORT BURSTS

PROCESSING

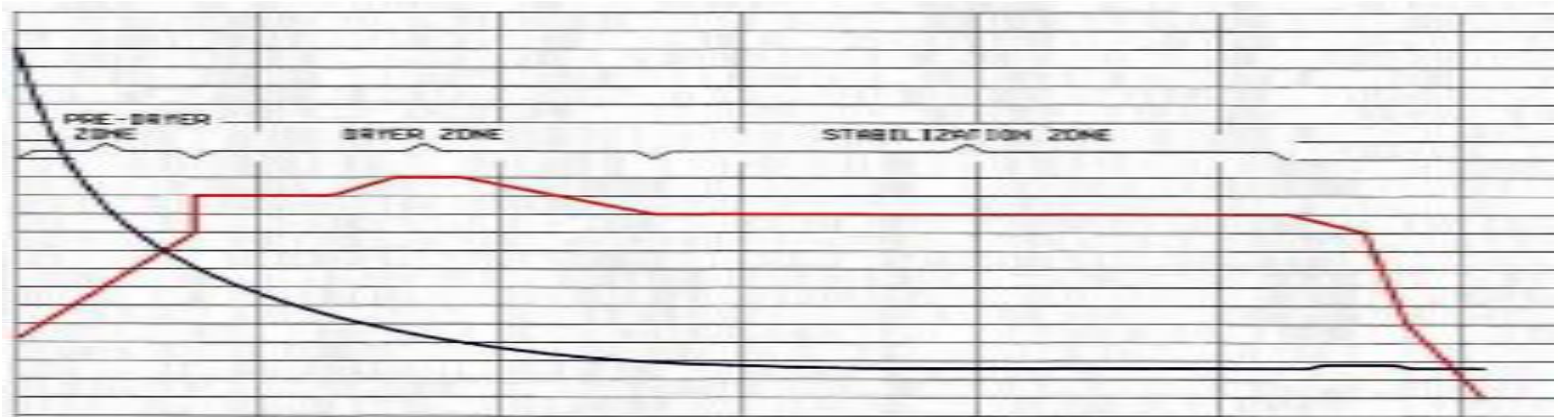
DRYING PARAMETERS

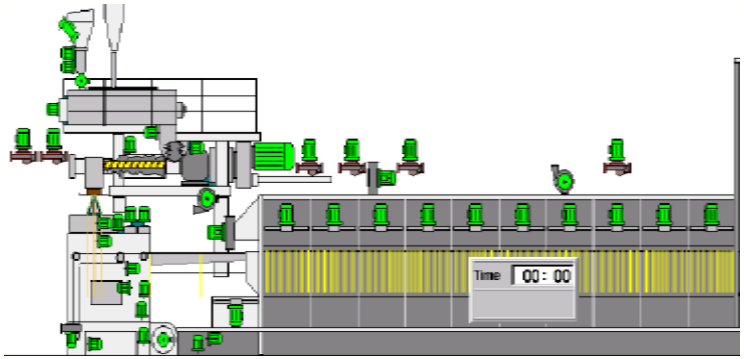
- MOST “REAL-LIFE” DRYING PROFILES ARE ACTUALLY HYBRIDS OF THE BASIC TECHNOLOGY “SCHOOLS”
- DRYING PROFILE IS HIGHLY DEPENDABLE ON THE RAW MATERIALS AVAILABLE
- DRYING PROFILE IS HIGHLY DEPENDABLE ON THE EQUIPMENT AVAILABLE (PHYSICAL LIMITS)
- LONG CUT PASTA TEMPERATURES TEND TO BE SOMEWHAT LOWER THAN SHORT CUT (SC MAY EXCEED BY 5-8C DEPENDING ON SHAPE

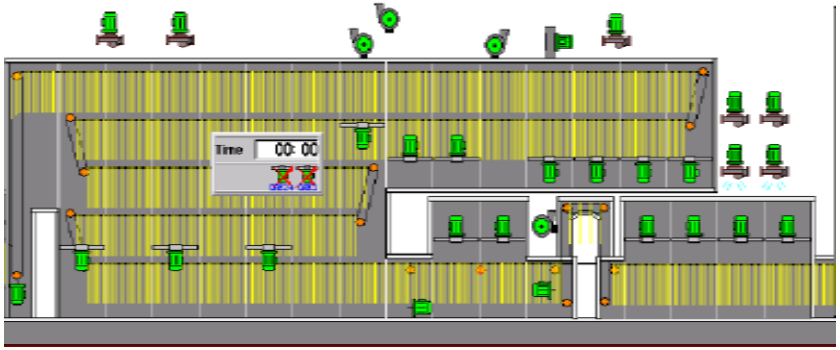
Optimize the drying curve



Technological phases







PROCESSING

DRYING PARAMETERS

TEMP STAGE	EFFECT
50-60C	• PROTEIN INTERACTIONS • STARCH/LIPID COMPLEXING WITH PROTEIN • ENZYMATIC ACTIVITY IS RAMPANT
60-70C	• ENZYMATIC ACTIVITY INITIATED (LIPOXYGENASES BLEACHING EFFECT) • PROTEIN DENATURATION + STARCH PARTICLE ENTRAPMENT PRIOR TO STARCH GELATINIZATION • FURTHER RS-SR FORMATION (DISULPHITE BONDS)
70-80C	• PARTIAL STARCH GELATINIZATION • PHENOLASE DEACTIVATION • FURTHER STRENGTHENING OF HYDROPHOBIC BONDING (GLUTEN DENATURATION)
80-90C	• FURTHER STARCH “PARTIAL” GELATILIZATION (ADDITIONAL LOSS OF BIREFRINGANCE) • MAILLARD ONSET
90+	• VISCOELASTIC PROPERTIES OF PASTA ARE IMPROVED • STARCH NOT COMPLETELY GELATINIZED

PROCESSING

DRYING PARAMETERS

KEY CONSIDERATIONS

ENZYMATIC ACTIVITY

- ENZYME DEACTIVATION IS CRITICAL IN COLOR PRESERVATION
- ENZYME DEACTIVATION CAN NOT TAKE PLACE BELOW 50C
- AT 60C SOME ENZYMES DEACTIVATE (OXIDASES, β-AMYLASES)
- LIPOXYGENASES, α-AMYLASES, PEROXIDASES, PHENOLASES REMAIN ACTIVE
- AT ABOVE 65C THE DEACTIVATION OF THE ABOVE TAKES PLACE
- PARTICULAR ATTENTION TO PHENOLASES (POLYPHENOL OXIDASE)
  - GIVES RISE TO BROWN COLOR (MELANIN) THROUGH A BIOCHEMICAL REACTION

RAW MATERIAL IMPROVEMENT

- VARIETY OF POSSIBILITIES FOR FLOUR IMPROVEMENT
  - ASCORBIC ACID
  - MONODIGLYCERIDES
  - ENZYMATIC IMPROVEMENT
  - COLOR IMPROVEMENT
  - VITAL WHEAT GLUTEN
  - FIBRE, ETC.

RAW MATERIAL IMPROVEMENT

- THERE IS NO “STANDARD” SOLUTION TO IMPROVEMENT
- AVAILABLE RAW MATERIALS, TECHNOLOGICAL LIMITATIONS, COSTS AND FINAL PRODUCT QUALITY REQUIREMENTS PLAY A FUNDEMENTAL ROLE IN THE IMPROVEMENT SOLUTION RECIPE/FORMULATION

RAW MATERIAL IMPROVEMENT

- MFM OFFERS CUSTOMIZED INGREDIENT SOLUTIONS (MILL LEVEL OR LINE LEVEL)
- SUPPORTED BY A FULL RHEOLOGICAL/CHEMICAL LABORATORY FOR MATERIALS AND FINISHED GOODS ANALYSIS
- “PRACTICAL TESTING AND TRAINING” SERVICES ON SITE USING EXISTING TRADITIONAL, HT AND VHT PRODUCTION LINES

PASTA SOLUTIONS…BY PASTA PRODUCERS

THANK YOU